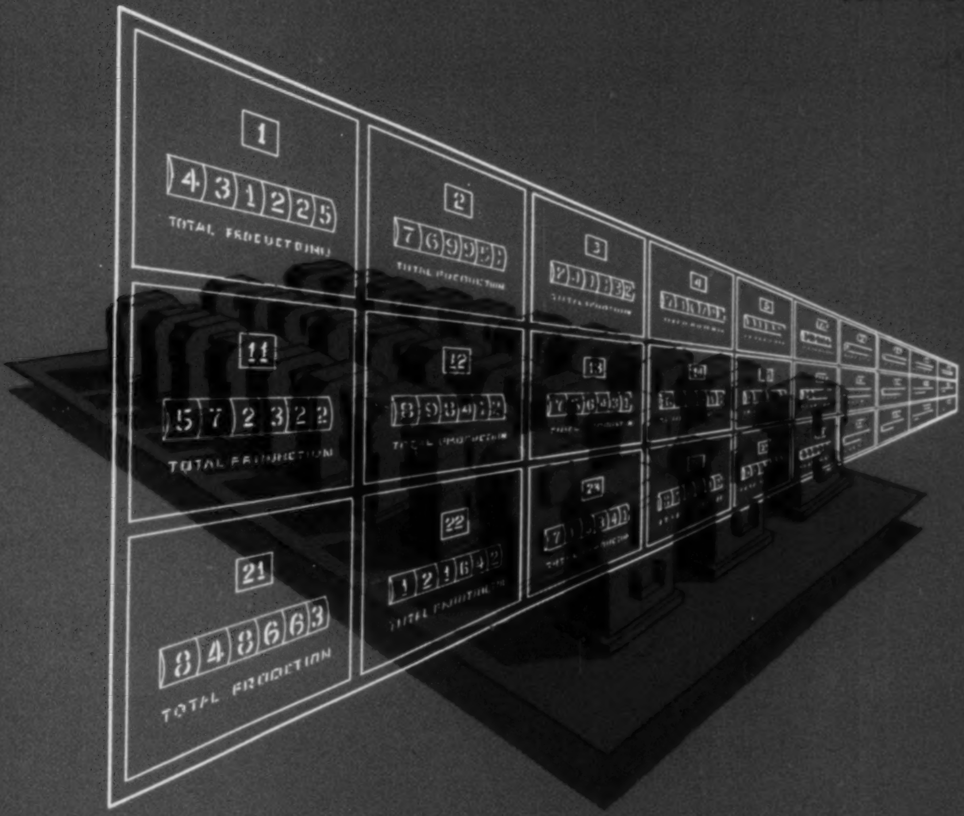
AUTOMATION

JULY 1961


1
431225
TOTAL PRODUCTION
2
11
572322
TOTAL PRODUCTION
12
21
848663
TOTAL PRODUCTION
22

Developing Control Systems

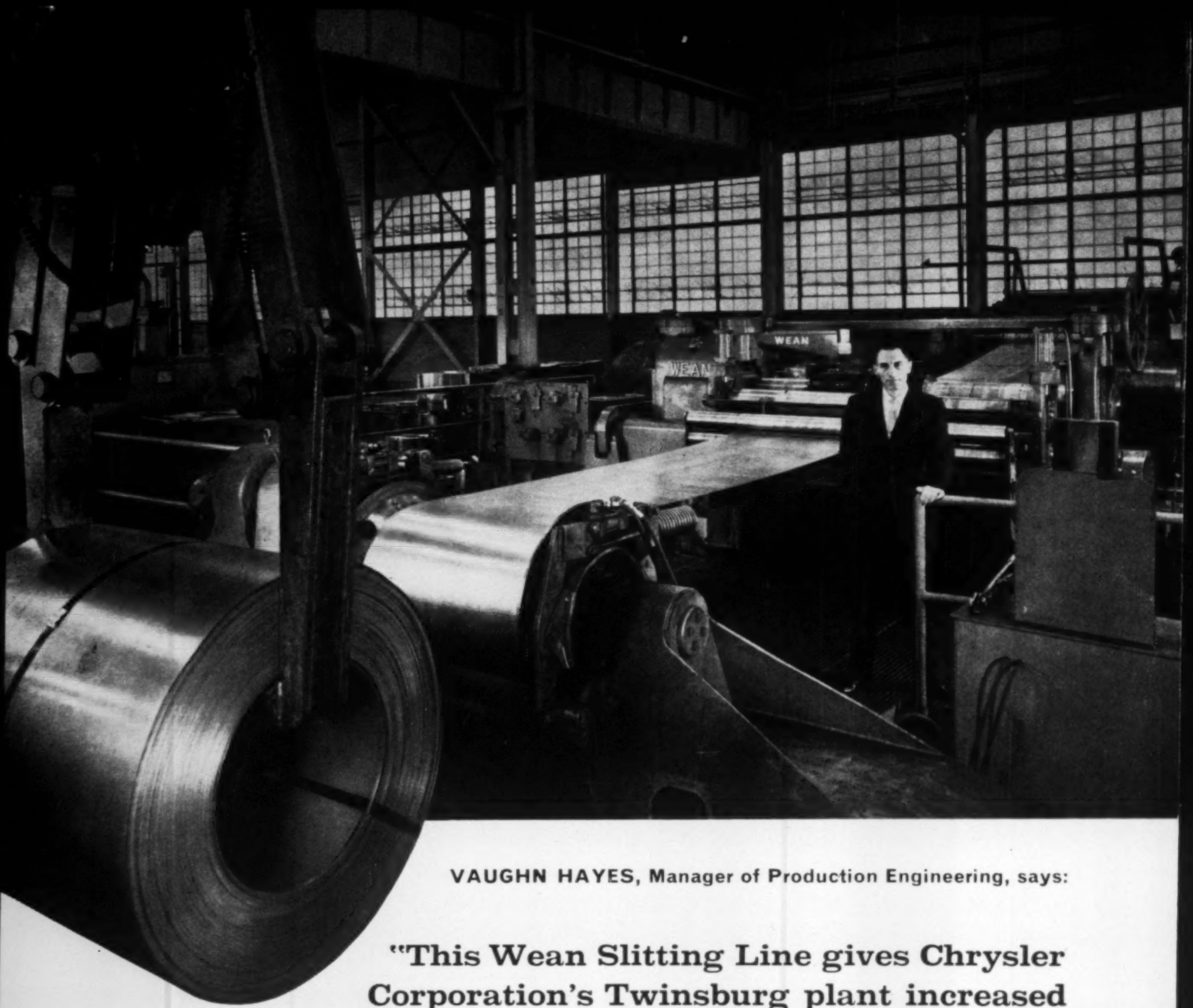
FOR AUTOMATED EQUIPMENT

THE MAGAZINE OF AUTOMATIC MANUFACTURING OPERATIONS

- **Manufacturing Engineering Today**
- **Automatic Diode Tester**
- **Card Controlled Order-Picking**
- **Automation in Newspaper Mailrooms**

CONTENTS—PAGE 3

A PENTON PUBLICATION



VAUGHN HAYES, Manager of Production Engineering, says:

"This Wean Slitting Line gives Chrysler Corporation's Twinsburg plant increased flexibility in production planning by allowing us to purchase standard size mill coils. We slit these coils to meet specific production requirements, eliminating special-width coil purchases. The line's 2,000 ton-per-month output helps us eliminate production delays and coil supply problems." Mr. Hayes' comments are typical of reasons why companies are using the *coil processing concept* to lower material costs, reduce inventory requirements and decrease scrap loss. If you process 500 tons or more per month of flat rolled metals, write for our new brochure entitled, "Coil Processing."

This brochure explains the concept and economics involved in *coil processing.* It also illustrates the types of Wean equipment that can help you cut inventory, production, and material costs when you process standard *mill* coils instead of sheets.

WEAN EQUIPMENT CORPORATION
22800 Lakeland Boulevard, Cleveland 17, Ohio Cable: WEANCOR

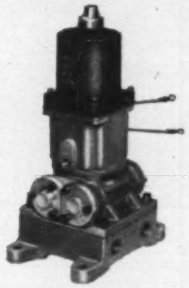
WEAN

Represented by these Associate Companies:
The McKAY MACHINE COMPANY (metalworking) • The WEAN ENGINEERING COMPANY, Inc. (primary steel)

Circle 651 on Page 19

The stock shelves at Ross include more different air valves than any other stock shelves in the valve world

Do you know these air controls by Ross?

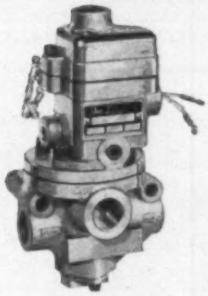


50 Million Cycles in Tests

Ross Goldmodel. A lightning fast, base mounted valve with its solenoid immersed in oil to run cool for long, long life. Full JIC. 3-way, 4-way and 4-way 5 port models. ¼″ through 1¼″.

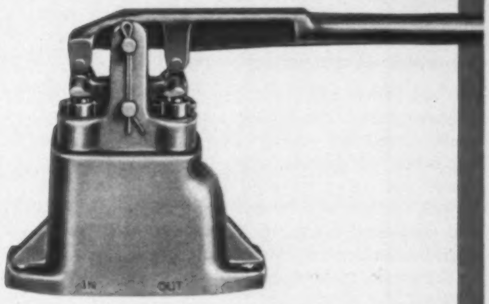
Control Cylinder Speed

Speed Control Valve. The adjustment screw directs air through an orifice that's engineered to give fine shadings of control at either high or low flow rates. ¼″ through 1¼″.



Does a Big Valve's Work

"Headline Series". Highest capacity valve-size for valve-size of any valve we've seen. Use a smaller, economical inline valve to do a bigger, more expensive valve's work. Fast. S-way, 3-way, 4-way. ¼″ through 1½″.



Especially for Tough Duty

Ross #100 series. Rough, tough jobs call for this valve which can pass most dirt and foreign matter with no trouble. Few moving parts and short poppet travel makes it especially wear resistant.

FOR OTHER ROSS VALVES SEE SWEET'S PRODUCT DESIGN FILE

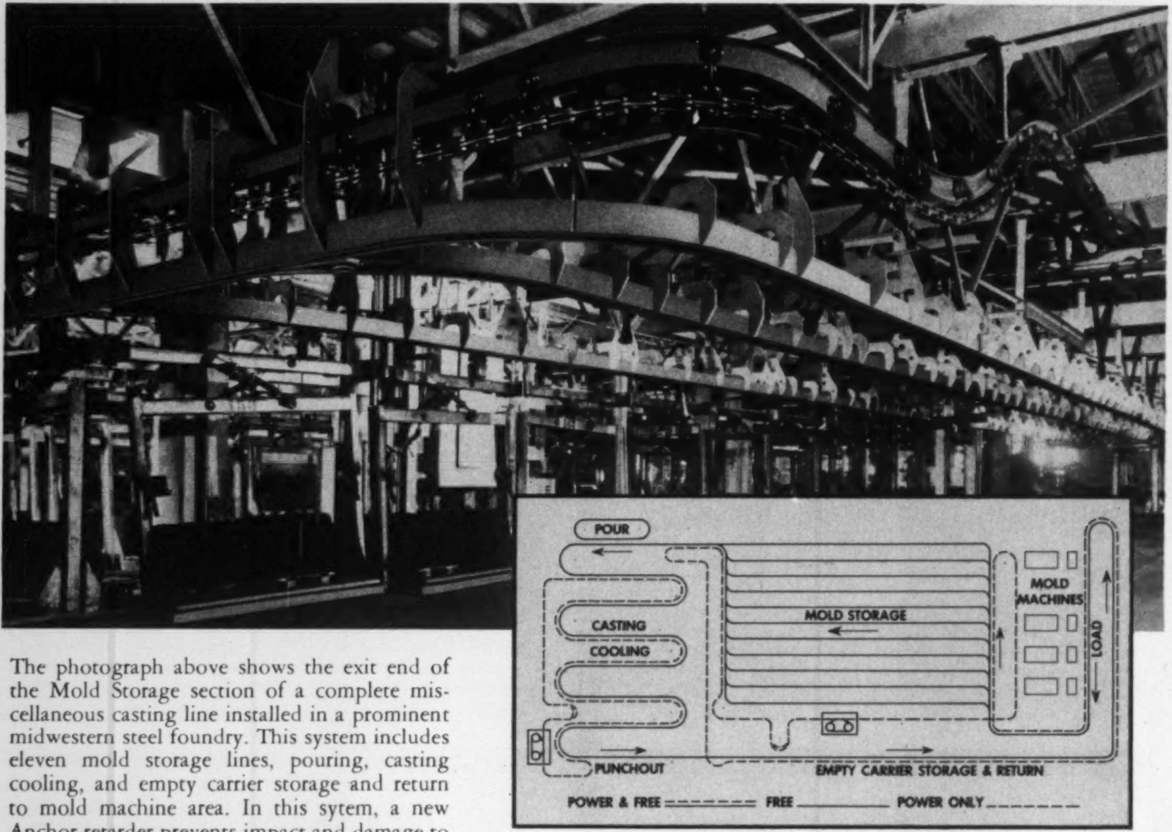
The most complete line of air controls in the world

Ross OPERATING VALVE COMPANY
131 E. GOLDEN GATE • DETROIT, MICHIGAN

Circle 654 on Page 19

ANCHOR "POWER AND FREE" CONVEYORS

introduce new concepts in manufacturing methods



TYPICAL ANCHOR FOUNDRY "POWER AND FREE" CONVEYOR

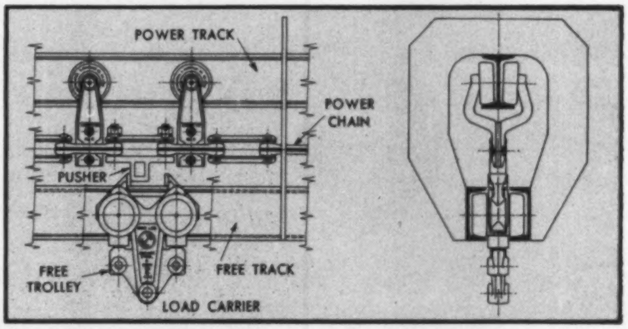
The photograph above shows the exit end of the Mold Storage section of a complete miscellaneous casting line installed in a prominent midwestern steel foundry. This system includes eleven mold storage lines, pouring, casting cooling, and empty carrier storage and return to mold machine area. In this sytem, a new Anchor retarder prevents impact and damage to the molds on the gravity storage lines.

Anchor Power and Free Conveyors combine the positive drive, fixed path features of conventional overhead trolley conveyors, with the flexibility of gravity type monorail systems. Loads can move through production steps by power, or they can be switched to gravity lines and switched back to power at any point. Carriers can be raised and lowered by lift sections in the track, rotated on turntables, or switched to meet any production requirement.

Automatic controls can be preset so that the carrier selects its own path and route through the various operations.

Anchor Power and Free Conveyors are available in several sizes for various load carrying capacities.

Because of the many layout possibilities and flexibility, we invite you to consult with our Power and Free specialists.



The Anchor Power and Free Conveyor consists of four-wheel load carrying free trolleys riding between two structural channels and pushed by a conventional overhead trolley conveyor mounted above the free track. Pusher dogs fastened to the overhead conveyor chain engage pivoted dogs on the free trolleys. When free track operation is desired, the free trolley can be switched off to one side, disengaging the pusher dog, or the power conveyor can be raised to clear the dogs on the free trolley.

ANCHOR manufactures all types of engineered floor and overhead conveyors

ANCHOR STEEL AND CONVEYOR COMPANY »»
CONVEYORS

DESIGNERS AND MANUFACTURERS
6906 KINGSLEY AVENUE • DEARBORN, MICHIGAN

Circle 655 on Page 19

JULY 1961
Vol. 8 — No. 7

The
Magazine of
Automatic
Manufacturing
Operations

AUTOMATION®
A PENTON PUBLICATION

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REGULAR DEPARTMENTS

Automation Outlook, 4
Automation News, 9
Around the Triangle, 17
Equipment Index, 18
Readers' Reply Card, 19
Meetings and Events, 24
Detroit Dateline, 53
International Scene, 57
New Equipment, 103
New Components, 117
New Literature, 137
Abstracts, 143
Confidential File, 148
Books, 150
Editorial Index, 152
Advertising Index, 154

EDITORIAL OFFICES
Penton Building, Cleveland 13, Ohio

None Too Good, 61

EDITORIAL—desire to avoid unscheduled downtime is big factor in choice of components of production equipment.

Manufacturing Engineering Today, 62

C. W. MORSE—discussion of manufacturing engineering and its role in the modern business organization performing production operations.

Automatic Diode Tester, 67

P. W. BECK—mounted on tape, components are indexed through two tests with rejects automatically severed from tape if failure occurs.

Card Controlled Order-Picking, 70

AUTOMATION TODAY—large warehouse order selection system holds 85,000 cartons which can be released at a rate of 1800 cases per hour.

Developing Control Systems for Automated Equipment, 76

H. R. CHOPE—properly developed systems can play a major part in improving productivity, upgrading quality, and lowering costs.

Multi-Actuator System Considerations, 83

J. CARPENTER—part two of a series on industrial hydraulic circuits describes sequencing of multiple actuators in phased relationships.

Automation in Action, 92

PICTORIAL PRESENTATION—machining with memory, inspecting pallets, marking tubes, loading pans on trays, wrapping bottles, rinsing cans.

X-Rays Control Sheet Thickness, 94

PROCESS CONTROL—gages continuously measure and control thickness of aluminum sheet product during rolling.

Automation in Newspaper Mailrooms, 95

B. L. MAYS—modern equipment helps solve principal problem of converting a stream of products into many batches of various quantities.

automation outlook

ATTITUDES

MANY of the recent comments regarding practical reform in capital equipment depreciation schedules are concerned primarily with the financial aspects. It is apparently taken for granted that specific pieces of equipment for specific processes must be replaced to obtain more efficient production. Very little attention is given the problem of whether such reform would really solve the basic problem of creating the climate for developing the radically improved methods needed.

The problem is not one of basic economics alone, it is also one for research. Is really better equipment available; is the method of production processing right; in fact, is the whole production concept valid under prevailing economic and technological conditions? The answers—the right answers—can only be ascertained by some careful research in production systems and concepts to determine how best the job can be done, and done more automatically.

It does not take much study to see that most depreciation arguments avoid the real issue—whether more advantageous rules would actually stimulate industrial modernization on a wide scale. Present practices raise serious questions in this regard.

According to studies made by Dr. James March, Carnegie Institute of Technology, the average firm really makes little search for better alternatives, existing methods being considered good enough. Our experience tends to confirm this finding. Rather than engaging in continuing serious search for more economic methods, backed by management decision to invest a percentage of income in this direction, the opposite is all too common and is apparent from the negative attitudes encountered.

Although reasonable depreciation is desirable as an incentive to modernize facilities and meet competition, little in fact will be accomplished by legislation alone. Management attitude holds the key. Swan Bergstrom, president of Cincinnati Milling Machine Co., nailed down the facts of life in a recent talk with this conclusion: "Our real solution to this problem, comes back to making a better product at a lower cost. . . . Our leadership in the future, as in the past, must be based on quality performance. The task is not a simple one, for it requires ever advancing innovations. It is our responsibility to see that our factories and our plants do not disintegrate by the creeping paralysis of obsolescence; obsolescence either in equipment or in new ideas and methods."

The future is up to industry. A well-planned program and an interested, positive attitude by management will produce some amazing results.

PUBLISHER AND EDITORIAL DIRECTOR

AUTOMATION

Penton Building, Cleveland 13, Ohio
Main 1-8260

ROGER W. BOLZ

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BPA NBP

...Fluid Power news

1921 OILGEAR 1961 40 Years of Fluid Power

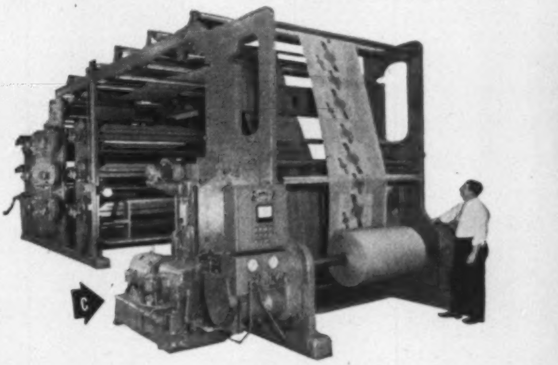
Report No. 12,301 — From Oilgear *Application-Engineering* Files

HOW OILGEAR *Any-Speed* DRIVE SYSTEMS ON *SCHMUTZ* 6-COLOR PRINTING PRESSES HELP BOOST PERFORMANCE, EFFICIENCY, ECONOMY, CONVENIENCE — IN LESS SPACE

CUSTOMER: *Schmutz Manufacturing Company, Louisville, Kentucky.*

PROBLEM: Main and rewind drives with control systems for web-fed, 6-color printing presses for printing packaging stock — from 50 or 60-lb kraft, to container and food board. Web widths vary from 40″ to 84″, with impression "repeat" varying from 14″ to 84″.

REQUIREMENTS: 1. Constant or absolute tension on the press section to provide "dot-to-dot" register over an infinitely variable (stepless) speed range from 0 to 1000 feet per minute . . . and hold set speed and tension without variation regardless of fluctuations in load, electrical power input, or temperature. 2. Provide either constant or tapering tension for rewind — from 4″ cores to 40″ or 60″ dia. rolls. 3. Must be economical from the standpoints of installed cost — operation and maintenance — floor space — and electrical power input. 4. Clean, quiet operation — with minimum heat dissipation. 5. To be "packaged" or pre-assembled for simplicity and speed of installation. 6. Eliminate, if possible, the long lineshaft drive that "closed up" one side of the press. 7. Be capable of dependable, trouble-free, continuous, 'round-the-clock operation.

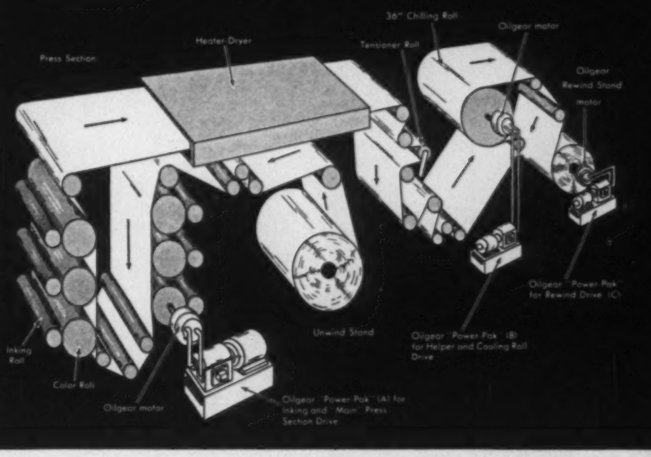


ABOVE: Rewind end of an Oilgear-equipped, 84″ Schmutz High Speed Press — with 84″ maximum impression repeat, speed range from 0 to 1000 fpm — with constant acceleration and deceleration rates. Oilgear Rewind Drive, indicated, can hold in stalled condition indefinitely — follow press speeds and rewind from a 4″ core to 60″ roll. The variable, constant or drooping tension characteristics with absolute constant or decreasing tension — without any steps whatsoever — enable this Oilgear-powered 6-color press to hold register closer than previously experienced.

SOLUTION: Three separate Oilgear Servo-Valve-Controlled Pump and Motor Drives to provide stepless, infinitely variable speed control. Fully interlocked feedback systems hold speeds and tensions to a new high degree of accuracy unobtainable with the adjustable speed electrical drives formerly used. An Oilgear "Plus" feature — "memory" — permits the press to be stopped for periods of several hours, and if not reset, will automatically resume operation at the identical former speed and tension. Space requirements are drastically reduced — *Oilgear Direct-Drive,* Fluid Power Motors are smaller than the gear reducers formerly required — and space consuming power rectifiers are eliminated. Operating economy has been improved — Oilgear Drives use less than ½ the former input power. Oilgear Drives do not require high-speed blowers for cooling — are whisper-quiet in operation . . . can hold stall-speed indefinitely without overheating. Another advantage—*lower installed cost.* These are some of the major advantages that help convince Schmutz to "join the swing" to Oilgear Drives and Control Systems . . . user satisfaction is, of course, the ultimate factor.

For example, one Schmutz customer reports — *"Our press is in operation 24 hours per day — 6 days per week. We can measure our Oilgear maintenance in nickels per year . . . with previous drives we had to carry $1000 worth of tubes in stock."*

OILGEAR *Application-Engineered* Fluid Power System For 6-Color Printing Press


36″ Chilling Roll
Oilgear motor
Heater-Dryer
Tensioner Roll
Press Section
Oilgear Rewind Stand motor
Oilgear "Power Pak" for Rewind Drive (C)
Unwind Stand
Oilgear "Power Pak" (B) for Helper and Cooling Roll Drive
Inking Roll
Color Roll
Oilgear motor
Oilgear "Power Pak" (A) for Inking and "Main" Press Section Drive

This is merely one of innumerable "problem drives" solved by Oilgear Application-Engineering teamwork — and Oilgear ANY-SPEED Drives and Control Systems . . . for new standards of performance — greater accuracy, precision control of speeds, torques, tensions . . . for new economy of operation, installation, maintenance, and valuable floor space . . . for longer, more dependable life. These are sound, basic, *installation-proved* reasons why there are more and more Oilgear users in the paper, printing and converting, marine, food and beverage, chemical, pharmaceutical, primary metals, metal-working, textile, rubber, military, and other industries who all agree that . . .

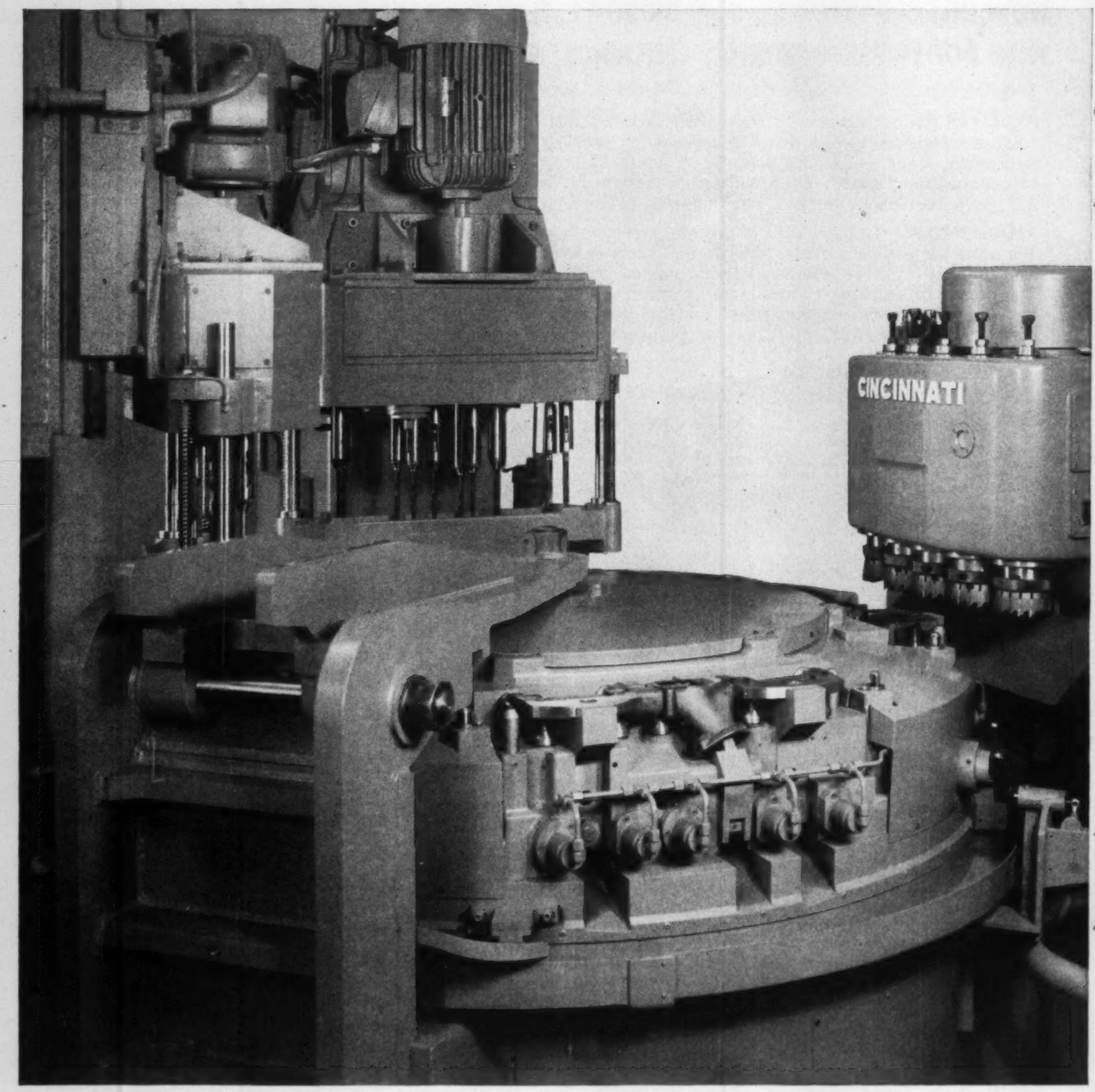
"for the lowest-cost-per-year . . . it's OILGEAR!"

For practical solutions to YOUR rotary or linear drive and control problems, call the factory-trained Oilgear Application-Engineer in your vicinity. Or write, stating your specific requirements, directly to . . .

THE OILGEAR COMPANY
Application-Engineered Fluid Power Systems
1598 WEST PIERCE STREET • MILWAUKEE 4, WISCONSIN
Phone: Mitchell 5-6715 — Direct Distance Dialing Code — 414

CINCINNATI

Rotary Index Machining..

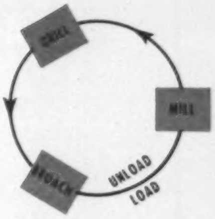


Milling, drilling and broaching operations are completed on exhaust manifolds at a production rate of 105 parts per 48 minute hour. Broaching is free, performed during the rapid index segment of the cycle.

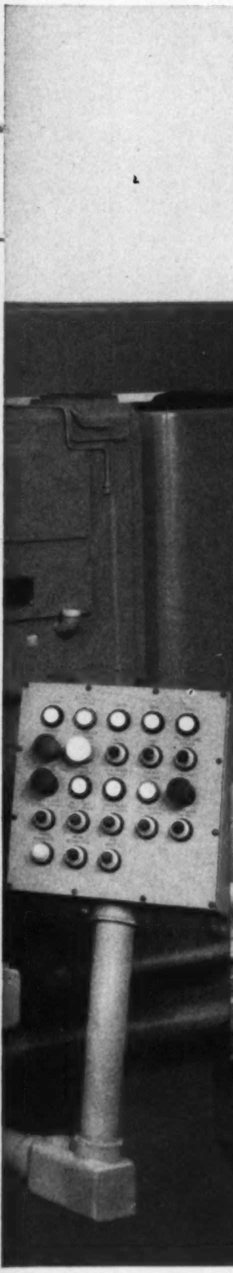
DESIGNERS AND BUILDERS OF SPECIAL MACHINES • HORIZONTAL BROACHING MACHINES •

THE CINCINNATI MILLING MACHINE CO., CINCINNATI 9, OHIO

..converts production lines *into*



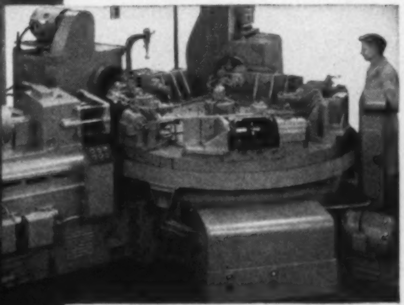
Space-saving circles

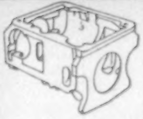


Take a conventional straight production line, bend it into a circle, and you have the basic idea of CINCINNATI Rotary Index Machines. These unique automatic machines take the work in a circular path which becomes the shortest distance traveled to achieve low-cost production.

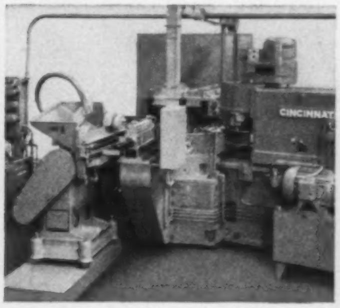
Cincinnati's Special Machine Division has built many highly successful machines of this type . . . some for milling, others for milling and drilling, while still others include a free broaching operation. Four examples are illustrated here. All include standard time-tested mechanisms which are used in other Cincinnati machines. And all incorporate the "building block" approach to construction, which reduces lead time . . . allows replacement of modules or units if required by design changes.

Cincinnati is staffed and equipped to build all types of numerically controlled equipment and automatic machines or production lines having any desired degree of automation. May we help you?

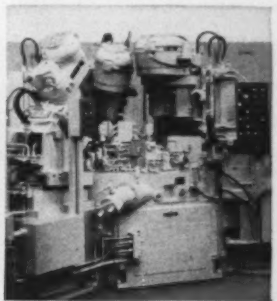


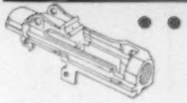


Milling, drilling and reaming operations are performed on transmission cases at the rate of 85 cases per 48 minute hour.



Automatic loading and unloading keep this CINCINNATI busily performing three operations on 600 cotton picker spindles per hour.





Thirty separate milling operations on complex gun receivers are performed by six CINCINNATI Station Type Rotary Machines.

COMPLETELY AUTOMATED PRODUCTION LINES

CINCINNATI®

SPECIAL MACHINE DIVISION

Circle 656 on Page 19

this air valve leaks

...15c worth of air

...in one year!

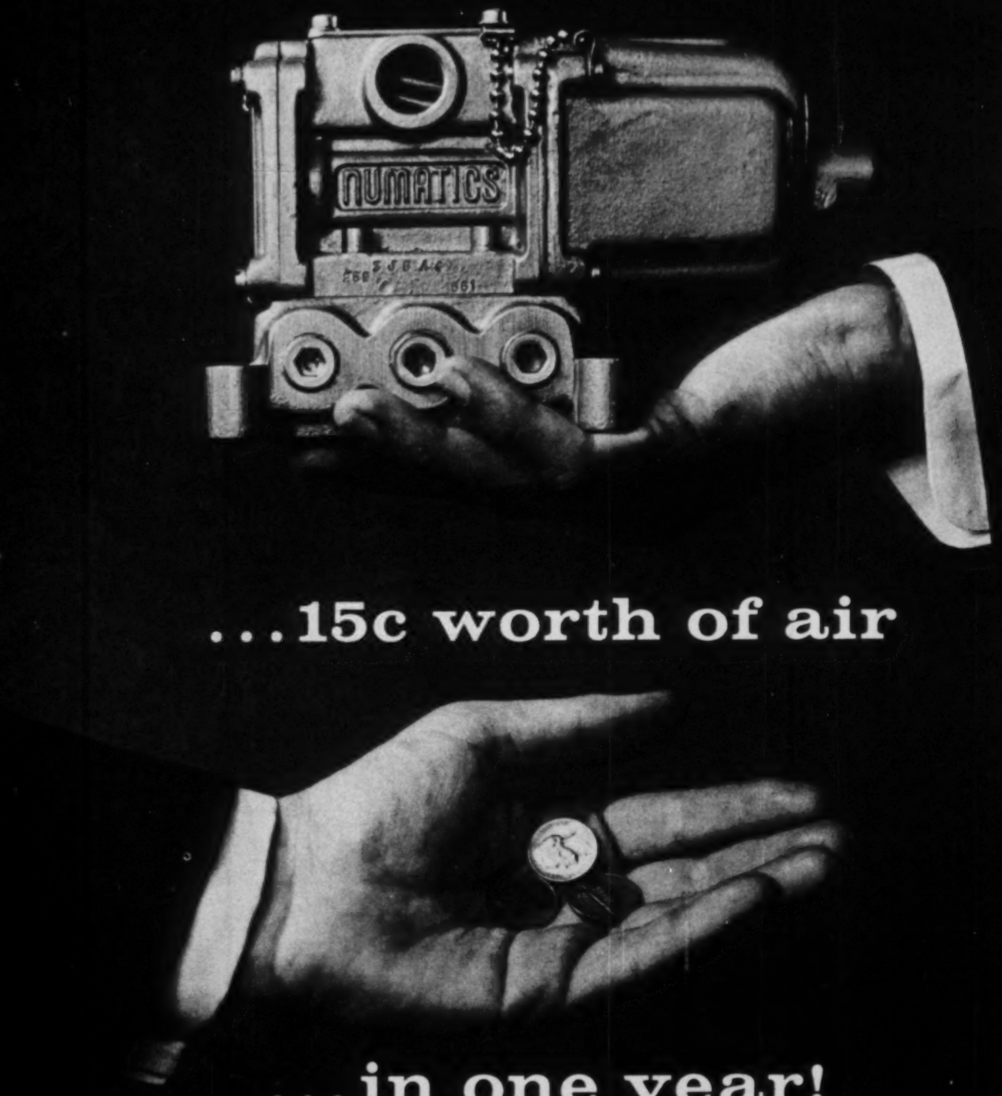
This valve leaks at a rate of about .003 C.F.M. or 15c worth of air in a year. During its unlimited service life the loss will drop to even less. Numatics valves *improve* with service. Unlike poppet valves, there is no blow by from intake to exhaust as the valve shifts.

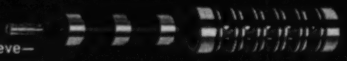
So what?

You pay 15c a year to get rid of working resilient seals and the inevitable down-time that results from seal failure in an air valve, because the Numatics valve *has no working seals.* Its stainless steel spool and sleeve, fitted to *millionths* of an inch, needs no working seals!

Run it on any standard lubricant, or run it dry, the Numatics valve is the most reliable air valve on the market!

Buy some!





The lapped spool and sleeve—
it works, and works, and works!

NUMATICS, Inc.

Highland, Michigan

AUTOMATION news

Today's events and developments in the field of automation

Department of Labor Creates Automation Organizations

TWO ORGANIZATIONS have been created in the Department of Labor to assist the Department in its efforts to develop programs for testing, counseling, training, and placement of workers whose employment opportunities are affected by automation and other technological developments. The new organizations are the Office of Automation and Manpower and the Advisory Committee on Automation and Manpower.

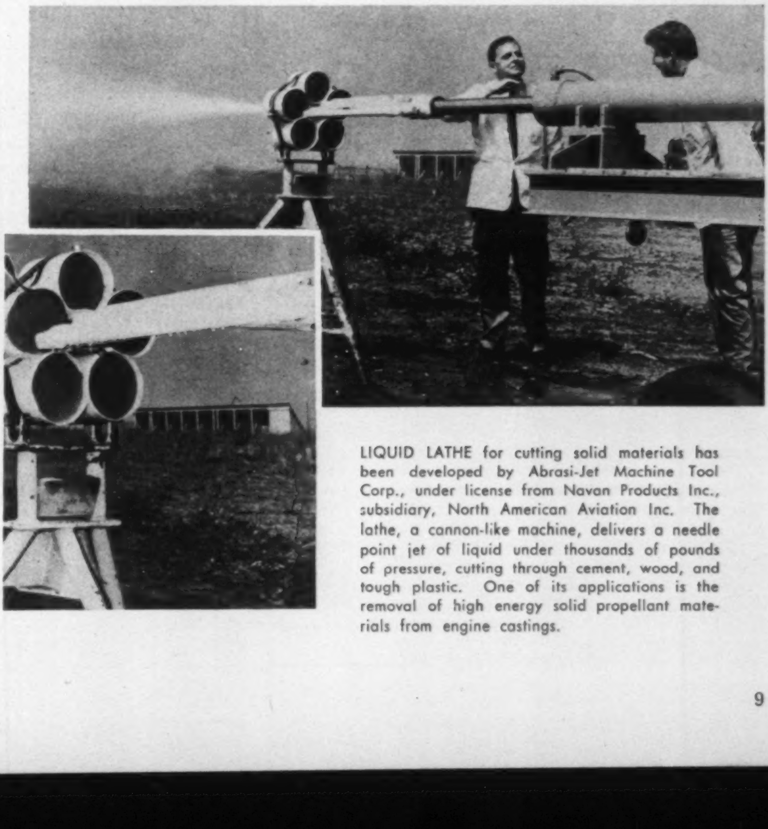
Function of the Office of Automation and Manpower is to examine employment and unemployment by industry, occupation, and area, current and anticipated technological changes; and all phases of technological unemployment. It will develop programs to expand and improve testing, counseling, training, and placement of workers to keep up with the changing demands resulting from automation and other technological developments. The office will also act as a clearinghouse for materials dealing with various aspects of automation and technological development, conduct conferences with employers and workers affected by automation and other technological developments, and prepare appropriate informational materials for distribution to interested persons and organizations. The resources and assistance of all the offices and bureaus of the Department of Labor will be available to the office. Director of the office is Deputy Assistant Secretary **Seymour L. Wolfbein.**

The Advisory Committee on Automation and Manpower is composed of 24 leaders in government, industry, labor, education, and industrial relations. The committee will meet periodically and will act as advisor to the Department of Labor in its effort to develop programs which are the responsibility of the new Office of Automation and Manpower. Units of the Committee will be organized as resource groups to concentrate on specific problem areas. Mr Wolfbein will chair the committee. Representatives from industry are: **Elwood C. Allen,** Staff Consultant, American Telephone and Telegraph Co.; **Roger W. Bolz,** Publisher and Editorial Director, AUTOMATION; **John Diebold,** John Diebold and Associates Inc.; **John J. Grebe,** Director, Nuclear and Basic Research Dept., Dow Chemical Co., **Emanuel R. Piore,** Research Engineer, International Business Machines Corp; and **John I. Snyder Jr.,** Chairman of the Board and President, U. S. Industries Inc.

Adds Static Machine Controls to Product Line

STATIC MACHINE controls have been added to the product line of Delco Radio Div., General Motors Corp. Heart of the controls is a transistor which is used as a switch. Transistors are used in basic logic circuits such as memories, amplifiers, timers, ANDS, ORS, and NORS. These functions are combined on printed circuit boards and twenty boards can be placed on one rack and programmed by the use of taper pin connections.

A separate power supply con-



LIQUID LATHE for cutting solid materials has been developed by Abrasi-Jet Machine Tool Corp., under license from Navan Products Inc., subsidiary, North American Aviation Inc. The lathe, a cannon-like machine, delivers a needle point jet of liquid under thousands of pounds of pressure, cutting through cement, wood, and tough plastic. One of its applications is the removal of high energy solid propellant materials from engine castings.

tains all voltages necessary for operation of the logic circuits and output devices such as solenoid valves. The voltages are regulated and interlocked to prevent damage to the machine.

Government Lists Inventions Wanted

DEVELOPMENTS needed by the Armed Forces are listed in a free publication entitled, *Inventions Wanted.* Published by the National Inventors Council, Office of Technical Services, U. S. Department of Commerce, the booklet describes 123 devices and improvements requested by the Department of Defense, covering virtually every field of scientific research.

Among the devices needed are a 25-hp hydraulic pump; a multipurpose pump weighing less than a pound, capable of pumping 30 to 40 gpm; and a quiet high-torque speed reducer able to handle 50 to 1000 hp. Production equipment for solid propellants and a multi-directional simple shock recorder are also needed.

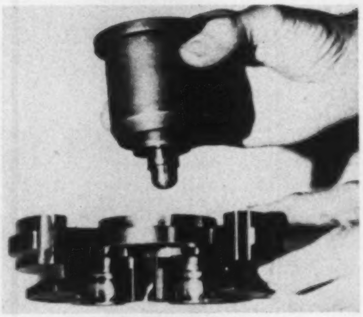
High School Students Study Programming

COMPUTER programming classes for high school students were organized by the Washington, D. C., Chapter of the Association for Computing Machinery and the Montgomery County (Md.) Board of Education. Some 300 students were enrolled in eleven voluntary courses. Ten of the courses held their classes on Saturday mornings; one course was given for credit on school time.

Students from three of the courses visited the IBM Space Computing Center in Washington to check out their computer programs on the IBM 709 computer and to learn how the machine works. The Federal Systems Div., International Business Machines Corp. provided free time on the computer The Education Committee of the Washington ACM Chapter also supplied motion pictures on computers and programming to the local schools and literature to the school libraries and students.

Unloading Barge is Automated

COAL BARGE unloading system designed by McDowell-Wellman Companies will be able to handle approximately 3000 tons of coal per hour. Barges to be unloaded are brought alongside a dock and attached to an automatic barge hauling system. Basic component of the barge unloading terminal is a rotary bucket wheel. The wheel scoops coal from the barge and it is delivered to a belt conveyor system. An operator positions the wheel initially and guides it through one cycle with the first barge in the terminal. The travel limits established in this cycle are registered on a memory tape which can be filed and fed to the controller whenever similar barges enter the terminal. The system is also designed with automatic protection against overload. If the wheel encounters unusual resistance during barge advance, the haulage engine will decrease its pull.



DUMMY GUIDE RINGS cast of hard-surfacing alloy are being used on glass container machines for a service life 50 times that of conventional cast iron guide rings. The guide rings are used in the finish ring equipment of the glass mold to guide the two halves of the neck ring during opening and closing. In the illustration, the halves of the neck ring are shown open and the plunger is included to show relationship of the neck ring to the plunger and thimble. The special alloy is supplied by Wall Colmonoy Corp.

ENTRY into the transistor test instrumentation field has been made by Fairchild Semiconductor Corp. Test equipment developed in conjunction with Fairchild's own transistor test program is available for sale or for lease. Equipment available includes: Automatic multi-parameter tester with automatic sorting and classification, data logger, lower limiting voltage tester, low leakage-current tester, and wide range dc pulse current gain tester. The multi-parameter tester makes four tests for voltage breakdown, two for lower limiting voltage, three for dc pulse current

CURRENT CONDUCTOR system developed by Ringsdorff Carbon Corp. for electrified fixed-track materials handling systems uses extruded copper rails mounted on steel T-bars. Efficient carbon pick-ups can be used with attendant features of low maintenance. The development was a winner of top honors in the 1961 Copper and Brass Achievement Awards competition of the Copper & Brass Research Association. In an installation in a midwest steel mill, the system provides ac current to cranes with a load capacity of 25 to 200 tons with conductor rails having current rating of 1300 amp. Because of their small size, the copper rails can be spaced only six inches apart. They also have sufficient strength to resist short circuit stresses and can retain enough resilience to spring out and back when forces might be applied.

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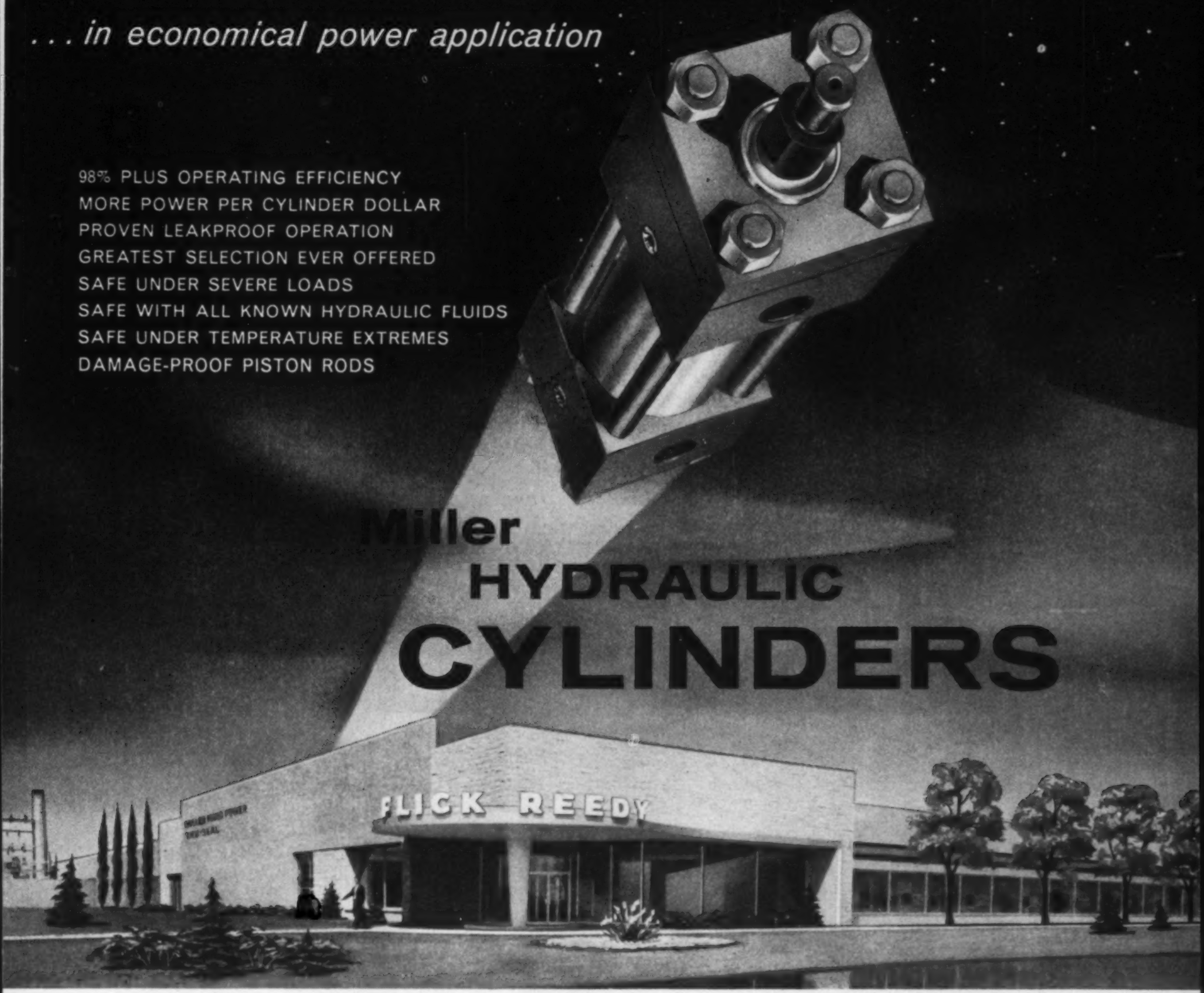

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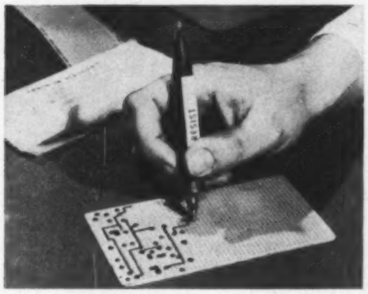
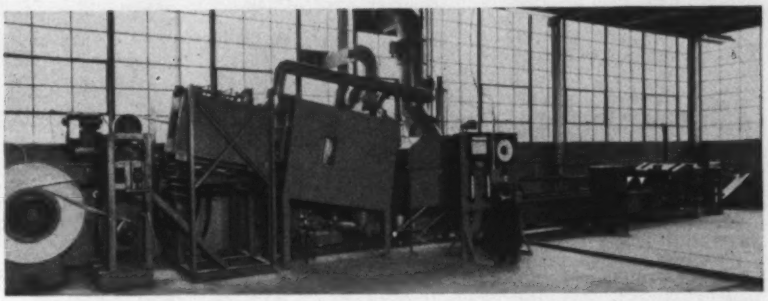
gain, two for saturation voltage and one for reverse current. The dc pulse current gain tester covers collector currents ranging from 1-599 ma with a base drive up to 500 ma. Collector voltage range is 0-29 v in 1 volt steps.

Improvements Sought in Papermaking

RESEARCH PROGRAM to improve the manufacture of paper through the use of computer control has been initiated at the Thomas J. Watson Research Center of the International Business Machines Corp. A number of paper companies and manufacturers of paper machines are co-operating in the project with IBM scientists involved in paper, ink, and control systems fields. Aim of the program is to produce paper having uniform predictable properties. To aid in this development, a scale-model of a Fourdrinier paper machine has been installed at the center. With the use of a digital computer, scientists will compute and adjust pressures, temperatures, flows, and other variables concerned with the papermaking process as the sheet paper travels through the machine. The scientists will also study the influence of real time control requirements for paper process machine design and test a theory which attributes many properties of paper to the state of the component fibers.



KIT which contains all materials required to make prototype printed circuits is made by Corning Electronic Components. Within 15 minutes, a designer can produce a printed circuit on glass-ceramic substrate. Package includes two 3 by 5-inch boards, grid paper for practice layouts, liquid etching resist for board circuit layout, vinyl resist tape, and ammonium persulfate crystals for making etching solution.



PILOT LINE demonstrates jet-spray process for applying molten salt to descale continuously moving stainless-steel strip. The process developed by Kolene Corp. uses a molten oxidizing salt to convert annealing oxides into soluble oxides that are easily removed in the electrolytic acid-pickle. In production, strip would leave the annealing furnace, go between jet-spray heads and through the pickle bath. After the pickle bath, the strip goes through a hot-water rinse booth and a conventional brushing station, then the strip is dried by heated air blasts before it is coiled. Speeds, concentrations, quantities, and temperatures are individually adjustable.

Film Available on Investment Analysis

EDUCATIONAL filmstrip on the MAPI system of investment analysis is available from Machinery & Allied Products Institute. The filmstrip and a printed script in a 24-page booklet are intended for presentation in one-hour discussion sessions. It is designed for engineers, financial personnel, salesmen, and executives who have the responsibility for providing information, completing, or reviewing the analyses on which investment decisions are based. The factors essential to systematic analysis of investment are discussed and a step-by-step procedure for application of the MAPI system is illustrated in a case example. This is the first of a series of visual aids planned by the Institute as part of its current program of research and education in business investment policy.

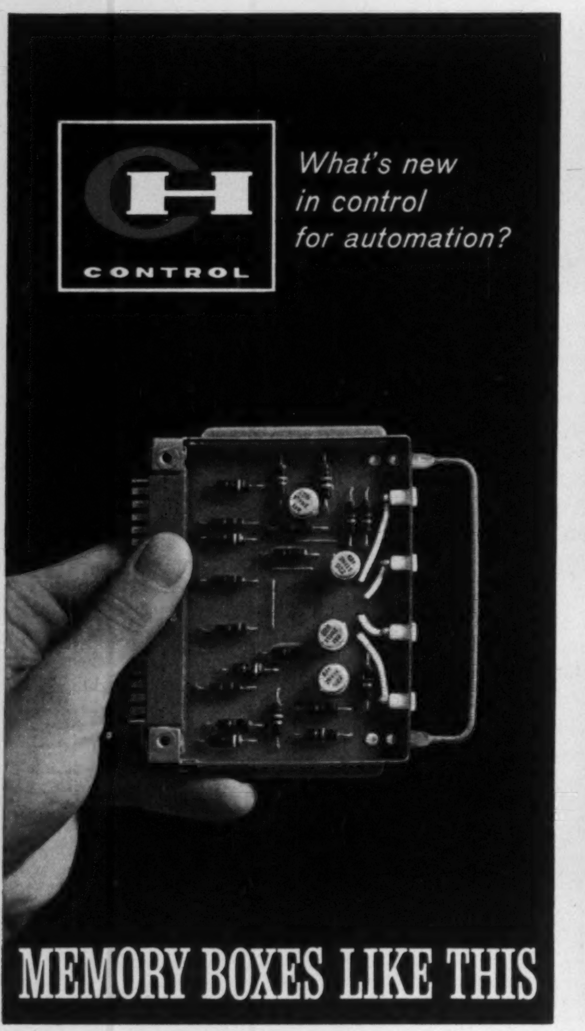
DIRECTORY of Manufacturers' Representatives has been revised to list more than 15,000 manufacturers' domestic and export representatives in the United States, Canada, and Puerto Rico. Listings are arranged geographically and include the principal products each agent carries and the trading area covered. Copies are available from Manufacturers' Agent Publishing Co.

ON-LINE process control system installed at the Roy S. Nelson steam generating plant of Gulf States Utilities operated continuously for 4200 hours without a computer failure from June 1960 through December 1960. It is used for data acquisition and process monitoring on a round-the-clock basis. Performance of the system developed by Information Systems Inc. indicates that electronic computer and control system reliability problems can be solved with today's technology.

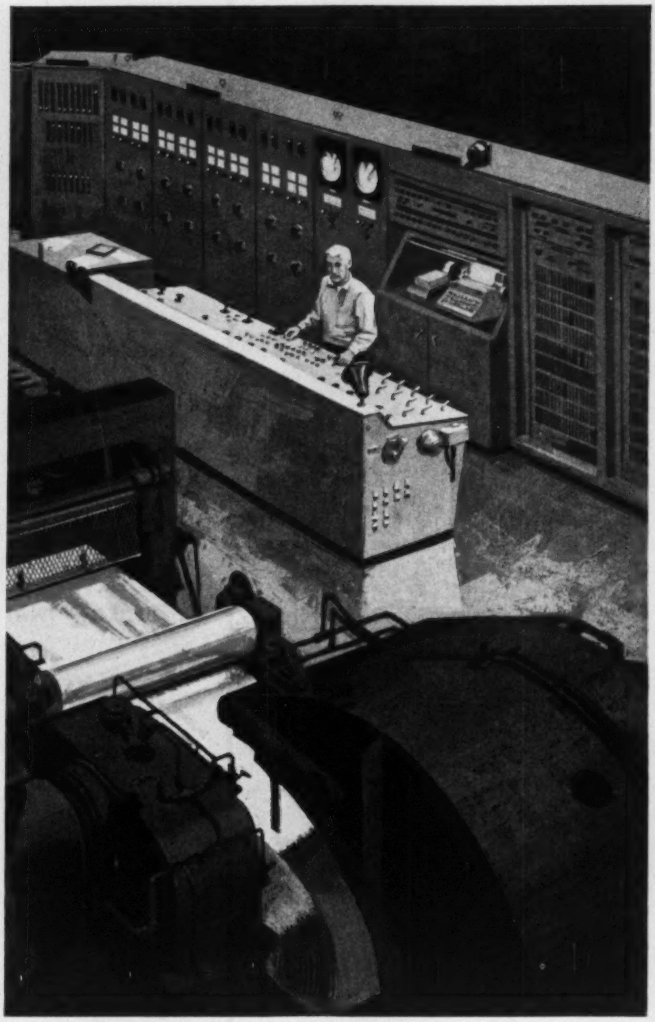
Lease Plan for Plants and Equipment

LONG-TERM sale and leaseback plan for plant and equipment has been initiated by Nationwide Leasing Co. Under this plan, companies can sell their existing plants and equipment and immediately lease it back for terms of from three to 12 years. Minimum amount that will be considered is $25,000 and there is no maximum. Every type of production and office equipment is included in the leaseback plan. It will also be possible to sell, for cash, fully or partially depreciated equipment to Nationwide at greater than book value and lease it back.

INFORMATION on the major uses of abrasive grain is contained in a series of booklets published by the Abrasive Grain Association. Two of the booklets cover the history and the physical and chemical properties of abrasive materials. The others are concerned with some phase of their use such as in bonded and coated abrasives, blasting, barrel finishing, super-re-



MEMORY BOXES LIKE THIS READ, RECORD, REMEMBER



SAVE MATERIALS . . . *to help a tinplate producer control quality,* Cutler-Hammer designed a computer that records quality in coils 3 miles long as the strip zips by at 1600 FPM. Automatically typed report shows defects and their exact location. Next automation step: process the data and close the loop by feeding the system instructions to provide automatic correction of process defects.

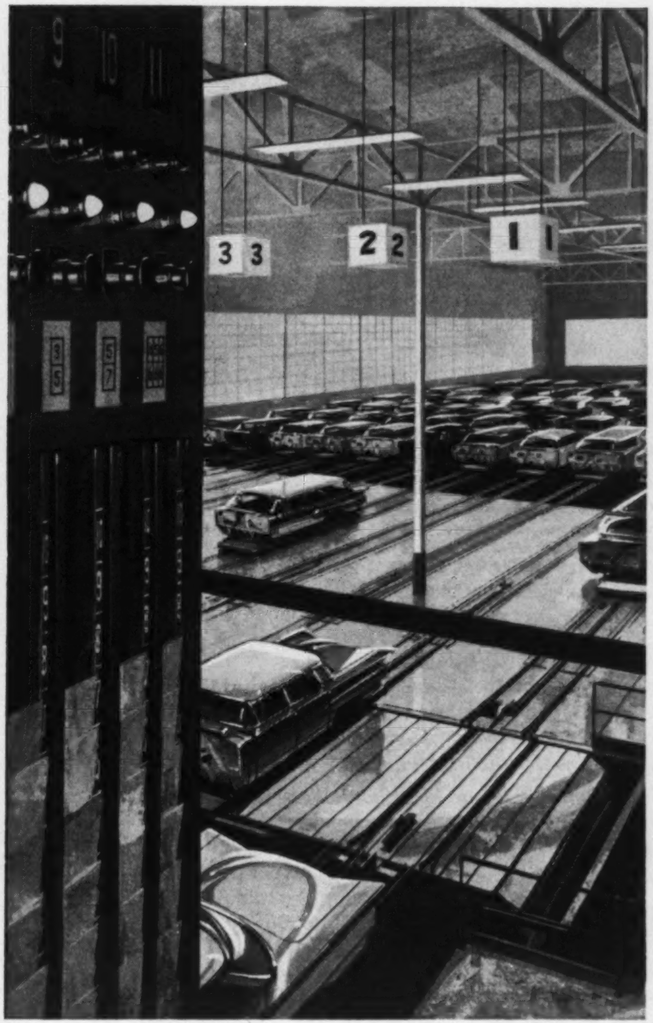
Memory boxes like this—digital modules in various combinations—are the key to *data accumulation,* basic to automation. Data accumulation provides *facts* that enable an operator to control a process better. It provides the *complete knowledge* of what is happening in a process that is an essential preliminary to complete automation.

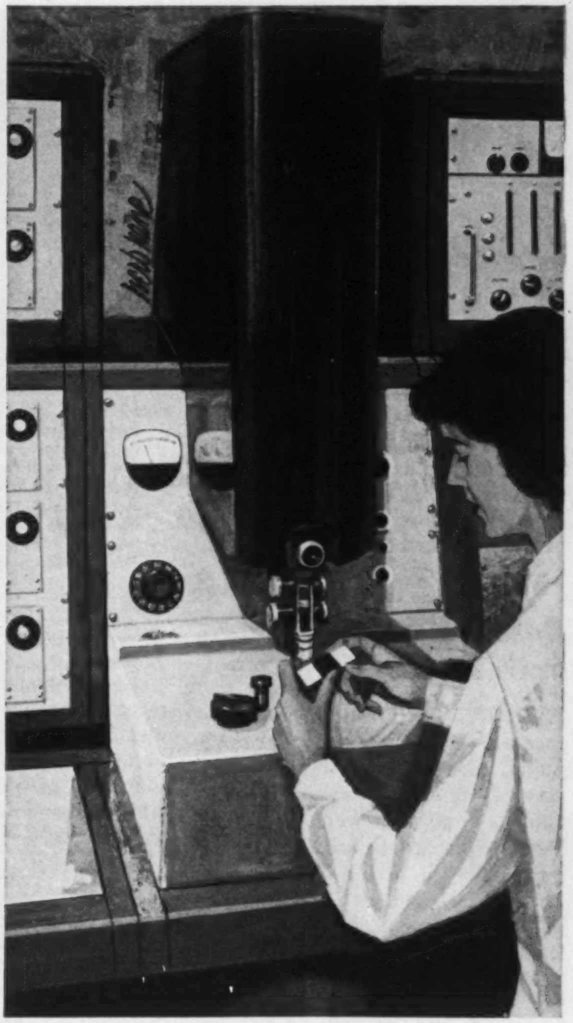
Three examples of data accumulation that have paid off are shown above. Applications are as broad as your problems and engineering imagination. Typical applications are designed to improve production and inventory control, to provide better sales forecasting, more intelligent production scheduling and cost control.

Automation systems designed by Cutler-Hammer run the gamut from material-handling systems that automatically regulate flow of car bodies from warehouse to assembly, to automatic blast furnace charging.

COMMON DENOMINATOR OF SUCCESSFUL AUTOMATION

You, and your automation planning team, can establish the needs for automation in your company far better than anyone else. But when objectives are determined, an automation control specialist can help you increase efficiency and cut costs . . . especially when he is *called in early.* He will help you select data processing equipment with the exact degree of sophistication for your needs; make sure that control and mechanical drive are compatible.





SAVE TIME . . . *to prevent production delays,* a buffer storage area between car body plant and assembly was designed by Cutler-Hammer engineers. One operator assigns body styles to assembly in sequence to maximize production, utilizing simplified data processing which "remembers" each car body location. This Cutler-Hammer idea saved the manufacturer many thousands of dollars.

SAVE LIVES . . . *to help detect cancerous cells* faster, a Cytoanalyzer developed by Cutler-Hammer's A.I.L. Division counts and classifies cancer cells according to nuclear size and density. This electronic slide scanning device greatly reduces time formerly required for visual examination. Early and regular cytological tests, made practical by this system, could reduce uterine cancer deaths substantially.

Employment opportunities are available for qualified engineers.

WHAT'S YOUR AUTOMATION OBJECTIVE?

Chances are Cutler-Hammer engineers can utilize their automation experience and adapt existing techniques to help solve your problem. Or, they'll use their ingenuity to develop a completely new concept. Either way, you have everything to gain from their experience. Why don't you call in your Cutler-Hammer man this week?

WHAT'S NEW? ASK...

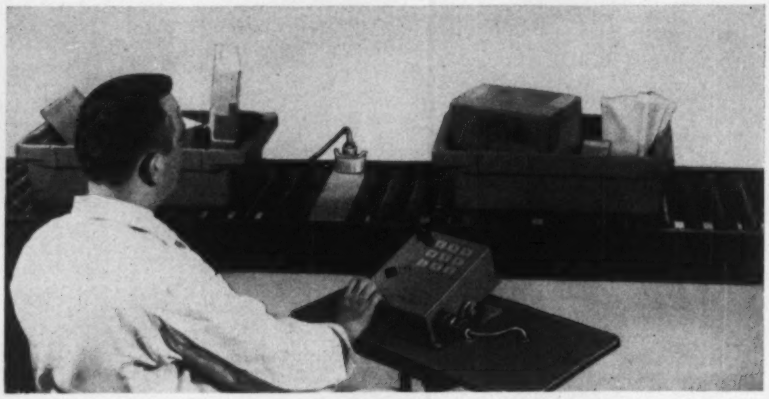
CUTLER-HAMMER

CONTROL

Cutler-Hammer Inc., Milwaukee, Wisconsin • Division: Airborne Instruments Laboratory • Subsidiary: Cutler-Hammer International, C. A. • Associates: Cutler-Hammer Canada, Ltd.; Cutler-Hammer Mexicana, S. A.

fractories, wire sawing, and polishing. The booklets also discuss the purpose of abrasive grain in the operations, factors influencing its use, types of abrasive grain used, reasons for their use, and methods of application.

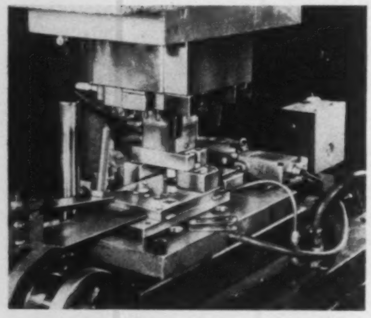
PROCESS for preparing aluminum alloys for electroplating with all commonly electroplated metals has been developed by MacDermid Inc. The process produces a zincate deposit by a series of treatments including an alkaline soak cleaner, two acid etches, an immersion coating, and a final copper strike. The process works well on all commercial aluminum alloys and can be varied to handle special alloys.



MAGNETIC routing system uses magnetic writing, memory, and reading methods in the automatic sorting and routing of containers, hampers, or tote trays. By means of a simplified keyboard, the operator selects the proper destination for a container. The keyboard information is translated into a code and transferred to a magnetic writing head. When the container passes the magnetic writing head, a magnet triggers the transfer of the code signal from the writing head to a magnetic memory code patch on the container. The coded container moves downstream until it reaches a reading head matching the code. The container is then diverted or emptied as required. System is designed by Atronic Products Inc. for conveyor speeds from 20 to 300 fpm.

Chemical Metering Movie Available

SOUND MOVIE on the development of equipment to meter and pump hard-to-handle liquids with no contamination or leakage is available to groups connected with the chemical processing industry. Prepared for the Process Equipment Div., Lapp Insulator Co., the movie shows the solution of current chemical metering problems in refineries, utilities, chemical plants, paper mills, and steel plants. Operating differences between piston, diaphragm, and combination piston-diaphragm metering pumps are demonstrated, and the evolution of the combination piston-diaphragm unit is shown. Common problems in installation and maintenance of metering units are discussed and solutions advanced.



TAPPING UNIT which can be built into progressive dies in any position has been developed by Laughter Corp. Design of this unit eliminates extra tapping operations in parts processed in punch presses. The unit is hinged so that taps can be quickly changed in less than one minute. Maximum tap size is $^3/_8$-inch with minimum center distance between tap holes of $2\frac{1}{2}$ inches. Actual production has run 75 strokes per minute tapping 4 threads in a workpiece.

ESTABLISHMENT of a new educational foundation has been announced by Drop Forging Association. To be known as The Forging Industry Educational and Research Foundation, the institution will provide scholarships and laboratory equipment as well as college textbooks in forging technology.

SPOTLIGHTING PEOPLE

P. Morris Burgess appointed specialist in load and frequency control systems for Special Systems Div., Minneapolis-Honeywell Regulator Co. . . . **David H. Baker** elected vice president of Vickers Inc., Div., Sperry Rand Corp. and general manager of its International Div. . . . **Edward F. Cannon** named works manager of Boston Gear Works, Div., Murray Co. of Texas Inc. . . . **James E. Campbell** appointed manager of the manufacturing section of Receiving Tube Dept. at General Electric Co. . . . **John E. Locke** named manager of diode operations for the Semiconductor Div., Hughes Aircraft Co. . . . **C. R. Stone** appointed director of production of Potter & Brumfield, Div., American Machine & Foundry Co. . . . **John J. Wallace** elected president and general manager of Prab Conveyors Inc. . . . **R. A. Sweet** named manager of the Systems Programming Dept. of Bendix Computer, Div., Bendix Corp. . . . **H. H. Gorrie** elected executive vice president and **J. H. Dennis** elected vice president in charge of all manufacturing activities and plants at Bailey Meter Co. . . . **Clyde Stufflebeam** and **Wayne Deaves** appointed development engineers in the Transducer Dept. of Schaevitz Engineering . . . **Richard S. Moyer** named director of manufacturing for Link-Belt Co. . . . **J. J. Sinacore** appointed plant manager of the Pearl River, N. Y. facilities of National Resistance Corp. . . . **E. Warren Feddersen** appointed director of manufacturing development at Convair Div., General Dynamics Corp. . . . **Norman H. Enenstein** promoted to director of technical administration of Litton Systems Inc. . . . **James C. Alemanni** joined engineering staff as a manufacturing engineer at International Resistance Co. . . . **William G. Zaenglein** appointed president of Clary Corp. . . . **William T. Engel** named chief engineer in charge of the Engineering & Design Dept. of Kahle Engineering Co. . . . **William**

around the triangle

MELTING ON THE BEAM

License to operate electron beam melting and casting furnaces has been granted to National Research Corp. by Stauffer Chemicals Co. The process has been used in the production of commercial quantities of refractory metals such as columbium, tantalum, tungsten, molybdenum, and their alloys. Currently, Stauffer is operating two 225 kw, one 300 kw, and three research furnaces to custom smelt, refine, and cast refractory metals on a toll basis and for the production of its patented special alloys.

CONVENTION RULES IMPROVED

New set of rules for exhibitors will be in effect at the 1961 Western Electronic Show and Convention in San Francisco, August 22-25. One rule will provide a special-interest area for production and processing materials, hardware, services and raw materials, designed to appeal to production engineers or managers and mechanical engineers. Other rules are that booths be manned at all times by persons qualified to discuss the products displayed, and that booths must not be used for employment solicitation.

VARIETY OF SHAPES WELDED

High frequency resistance welding developments by Thomson Electric Welder Co. offer new ways for welding a broad range of shapes at high speed. Now it is possible to use this method to weld as many as eight steel and stainless strips to a small diameter tube to form radial fins at speeds of 160 fpm and better. Immediate application is expected to be found in heat transfer equipment such as used in power stations and atomic reactors where strips of steel or stainless steel must be welded to piping. The welding process is also feasible for copper, aluminum, zirconium, and exotic metals.

INPUT-OUTPUT STANDARDIZATION

Reorganization of technical activities in the Electronic Industries Association has resulted in a realignment of engineering committees working on standardization of input and output devices. TR-27.6, the Subcommittee on Input and Output Equipment, will include the following sub-subcommittees: TR-27.6.1 Cards, Punched, Printed and Aperture, and Card Input and Output Equipment; TR-27.6.2 Tapes, Punched and/or Printed and Tape Input and Output Equipment; TR-27.6.3 Magnetic Tapes and Magnetic Tape Input and Output Equipment; TR-27.6.4 Document Reading; and TR-27.6.5 Analog-Digital Conversion. H. L. Tholstrup, chairman of Subcommittee TR-27.6, invites participation by industry representatives.

PACKAGED DATA SYSTEM

Packaged computer system that can be adapted for use in any power generating station with a minimum of special programming has been developed by the Process Computer Section, Industry Control Dept., General Electric Co. Known as the GARDE system, it gathers, alarms, reports, displays, and evaluates data from several hundred inputs. System is designed around GE's transistorized 312 digital process control computer. Function of the system is to gather data to central locations, compute hourly over-all heat rate and component efficiencies, check operating values for out-of-limit conditions, automatically prepare logs, and automatically record values exceeding preset limits.

AUTOMATION

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INDEX OF EQUIPMENT BY ITEM NUMBERS

(New Equipment, New Components, and New Literature covered in this issue)

Analyzers, servo systems, 475
Assembly machine, 415

Borers, jig, 459
Brakes, magnetic disc, 464
Buffing machine oscillating attachment, 433

Card reader, 422
Carton imprinter, 438
Chamfering machine, 421
Chain, circular roller, 484
Chain, conveyor, 484
Cleaner, tote box, 419
Control systems, 414
Controllers
  digital set point, 476
  temperature, 436
  thermocouple vacuum gage, 443
Controls
  density, 453
  gravity, 453
  magnetic conveyor, 481
  photoelectric, 478
Converters, data, 408
Conveyor controls, magnetic, 481
Conveyors
  index, 420
  trolley, 456
Counters
  electric, 430
  parts, 401

Data processing
  card reader, 422
  data punch, 442
  memory, 449
  paper tape converter, 408
  punched card switch, 431
  tape preparation equipment, 470
  tape punches, 458
  tape readers, 416, 458
Data punch, 442
Detector, motion, 466
Digital voltmeter, 440
Drilling machines, 415
Drives
  magnetic disc brakes, 464
  motor, 480
  motor starters, 444
  pulleys, 429

Electrical components, 427, 431, 435, 439, 445, 448, 463, 471, 473, 482
Electrical indicating panel instruments, 469
Electroplating processes, 483
Exploded view illustrations, 454

Feeders
  parts, 426
  transfer, 402
Filter element, metal, 437
Finishing
  cleaning, 455
  flow coating, 455
  machine, 424
  metal, 455, 483
  rustproofing, 455
  tote-box cleaner, 419
Fittings, tube, 462
Forming machine, thread, 413
Furnace, zone leveling and refining, 409

Gages, nuclear, 453
Generators, synchronous, 471
Grinder, double-end internal, 467

Handling
  circular roller chain, 484
  conveyors, 420, 456
  feeders, 426
  manipulator-vehicle systems, 472
  stack height selector, 423
  transfer feeders, 402
Height selector, stack, 423
Hydraulic blanking press, 479
Hydraulic broken-line indicators, 434
Hydraulic components, 432, 447
Hydraulic motors, 439

Illustrations, exploded view, 454
Imprinter, carton, 438
Indexing machine, 405
Indexing machine chassis, turret, 425
Indicators
  hydraulic broken line, 434
  self-balancing, 451
Instrument controls, 430, 436, 446, 466, 476
Instrument indicators, 440, 443, 451, 469

Jig borers, 459

Labeler-imprinter, 417
Leveling furnace, horizontal zone, 410
Limit switches, 482

Machine chassis, turret indexing, 425
Machine tools
  blanking press, 479
  chamfering, 421
  cutting, 405
  drilling, 405, 407, 415
  grinder, 467
  jig borers, 459
  milling, 405
  tapping, 405, 407, 421
Machines
  assembly, 415
  finishing, 424, 483
  measuring, 418
  parts counter, 401
  plating, 403
  terminal riveter, 411
  thread rolling, 460
  thread rolling and forming, 413
  turning, 421
  uncoiler, 412
  welding, 404, 477
  wire straightening, 405
  zone leveling and refining furnace, 409
Magnetic conveyor controls, 481
Magnetic disc brakes, 464
Magnetic starters, 468
Marking
  carton imprinter, 438
  labeler-imprinter, 417
Measuring
  density controls, 453
  gravity controls, 453
  hole location, 418
  pressure transmitter, 428
  temperature controller, 436
  thermocouple vacuum-gage controllers, 443
  timer, 450
  viscometer, 446
  weight sensing systems, 461
Memory, magnetic core, 449
Metal finishing equipment, 455
Metals
  properties, 465
  selection, 465
Mixing heads, foam, 441
Motion detector, 466
Motor drives, 480
Motor starters, 444
Motors, hydraulic, 439

Nuclear gages, 453

Oscillating attachment, buffing machine, 433

Packaging
  checkweigher, 410
  labeler-imprinter, 417
  parts counter, 401
Parts
  counter, 401
  feeder, 426
Photoelectric controls, 478
Plating machine, 403
Pneumatic components, 452
Press, blanking, 479
Pressure transmitter, 428
Pulleys, V-belt, 429
Pumps, vacuum ion, 474

Readers
  card, 422
  tape, 416
Recorder, web width, 406
Rectifiers, 463
Refining furnace, horizontal zone, 409
Relays, 463
  cradle, 435
  current-sensing, 448
Riveter, turret terminal, 411
Roller chain, circular, 484
Rolling machine, thread, 413, 460

Servo system analyzers, 475
Solenoid valves, 457
Solenoids, rotary, 463
Starters
  magnetic, 468
  motor, 444
Steppers, rotary, 463
Switches, 463
  commutating, 445
  limit, 482
  punched card, 431

Tape
  preparation equipment, 470
  readers, 416
Tapping machines, 421
Terminal block, 427
Thread rolling machine, 460
Timer, electric, 450
Transformers, 463, 473
Transmitter, pressure, 428

Uncoiler, processing - line, 421

Valves
  hydraulic, 447
  pneumatic, 452
  remote control, 432
  solenoid, 457
Viscometer, 446
Voltmeter, digital, 440

Web guide power unit, 406
Weighing machine, 410
Weight sensing systems, 461
Welder, projection, 404
Welding machinery, 477

401-426—NEW EQUIPMENT—*page* 103 **427-452—NEW COMPONENTS—*page* 117**
453-484—CATALOGS & LITERATURE—*page* 137

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Page No. Title of Article

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406	436	466	496	526	556	586	616	646	676	706	736	766	796	826	856
407	437	467	497	527	557	587	617	647	677	707	737	767	797	827	857
408	438	468	498	528	558	588	618	648	678	708	738	768	798	828	858
409	439	469	499	529	559	589	619	649	679	709	739	769	799	829	859
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413	443	473	503	533	563	593	623	653	683	713	743	773	803	833	863
414	444	474	504	534	564	594	624	654	684	714	744	774	804	834	864
415	445	475	505	535	565	595	625	655	685	715	745	775	805	835	865
416	446	476	506	536	566	596	626	656	686	716	746	776	806	836	866
417	447	477	507	537	567	597	627	657	687	717	747	777	807	837	867
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419	449	479	509	539	569	599	629	659	689	719	749	779	809	839	869
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424	454	484	514	544	574	604	634	664	694	724	754	784	814	844	874
425	455	485	515	545	575	605	635	665	695	725	755	785	815	845	875
426	456	486	516	546	576	606	636	666	696	726	756	786	816	846	876
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428	458	488	518	548	578	608	638	668	698	728	758	788	818	848	878
429	459	489	519	549	579	609	639	669	699	729	759	789	819	849	879
430	460	490	520	550	580	610	640	670	700	730	760	790	820	850	880

AUTOMATION **JULY 1961**

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CARD INVALID WITHOUT COMPANY NAME—TYPE OR PRINT

NAME ______________________
TITLE ______________________
COMPANY ______________________
PRODUCT MANUFACTURED ______________________
ADDRESS ______________________
CITY ______________________ ZONE ______
STATE ______________________

This card good until September 15, 1961

401	431	461	491	521	551	581	611	641	671	701	731	761	791	821	851
402	432	462	492	522	552	582	612	642	672	702	732	762	792	822	852
403	433	463	493	523	553	583	613	643	673	703	733	763	793	823	853
404	434	464	494	524	554	584	614	644	674	704	734	764	794	824	854
405	435	465	495	525	555	585	615	645	675	705	735	765	795	825	855
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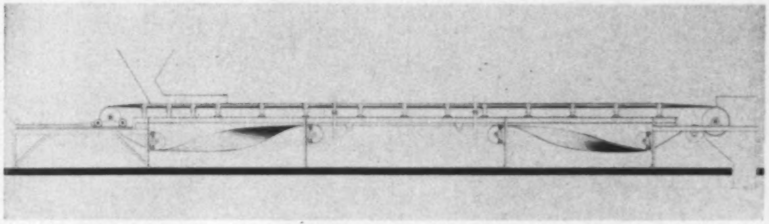
C. Grimes appointed senior field service engineer of the Scientific and Process Instruments Div., Beckman Instruments Inc. . . . **Ian F. Thomson** named manager of components assembly at Non-Linear Systems Inc. . . . **Bev Willison** appointed production manager of Atkron Inc. . . . **D. M. Rosencrans** named general manager of the Klipfel Valve Div. and Economy Pump Div., Hamilton-Thomas Corp. . . . **Thomas J. Watson Jr.** elected chairman of the board and **Albert L. Williams** appointed president, both at International Business Machines Corp. . . . **J. Arnold Kiely** named executive vice president and **Robert R. Rhodehamel** appointed vice president in charge of manufacturing, both at Cone Automatic Machine Co. Inc. . . . **Henry J. Killmar** named manager of the new products branch of the Research and Development Div., Carborundum Co. . . . **William F. Peschel** appointed manager of the Induction Heating Equipment Div., Olsen Mfg. Co. . . . **Dr. Leon Davidson** named manager of the programming section of the Engineering Dept. of Teleregister Corp. . . . **Carl Wasserman** appointed manager of the high speed printer product line at Potter Instrument Co. . . . **W. A. Irvine,** manager of production engineering for Maytag Co., elected president of the Metal Powder Industries federation. . . . **Dr. Donald H. Bullock** named director of programmed teaching services group at Auerbach Electronics Corp. . . . **Cruse W. Moss** became executive vice president of Willys Motors Inc. . . . **William L. Brian** appointed executive vice president of Farrington Business Machines Corp.

SPOTLIGHTING PLANTS

Bliss & Laughlin Inc. will build a $2 million cold finished steel bar plant in Medina, Ohio. . . . **American Steel and Wire, Div., United States Steel Corp.,** has formed a combined engineering, research, and product development department to develop new markets and products. . . . **Robertshaw-Fulton Controls Co.** has renamed its Mairco Div. as the Mid-West Development Center. Function of the new center will be to develop new products in domestic and commercial control fields. . . . **Lynch Corp.** has acquired the Coblentz dry air systems from the Lovell Mfg. Co. The systems can be used in any industry using compressed air. . . . **U. S. Drill Head Co.** has moved its operations into three new buidlings on a 14-acre site. The largest building, occupying 29,000 sq ft of space will house the offices, engineering department, and manufacturing facilities for the machine tool division. Other buildings include a foundry and pattern shop. . . . **McKay Machine Co.** will build a plant and office building on a 34 acre site in Youngstown. The project is estimated to cost $4½ million. . . . **American Datamatic Inc.** has acquired the Data Systems Div. of American Electronics Inc. Under terms of the agreement, all inventory, drawings, specifications, patents, and tooling will be transferred to American Datamatic. . . . **Heald Machine Co.** has been reorganized into two main divisions by product line—the Grinding Machine Div. and the Bore-Matic Machine Div. . . . **National Cash Register Co.** is expanding its marketing facilities



CONVEYOR BELT system has a turnover feature that allows belts to twist automatically, reversing top and bottom surfaces after delivering and before accepting a new load. Object of the turnover action of the belt, developed by B. F. Goodrich Industrial Products Co., is to position the clean side of the belt on top of the return idlers. Twisting action is accomplished by placing two twist pulleys at each end of the belt flight. Each set of twist pulleys turns the belt 180 degrees. The belt's thick carrying cover is always positioned to receive the load and the return idlers contact only the clean side of the belt. System can be applied to conventional conveyor systems now in operation.

PSC DISCONNECTS

AIR - GASES - FLUIDS
PNEUMATIC TOOLS
INSTRUMENTATION
AUTOMATION

PUSHOMATIC ®

Small compact couplings, PUSHOMATIC one-hand connect or disconnect. Automatic locking — high-pressure connection. Maximum flow.

- One-hand operation
- Automatic action
- Integral shut-off
- 360° swivel action

INTERCHANGEABLE

Interchangeable with all popular makes. Fast, easy one-hand "push" action connects or disconnects lines instantly.

- Interchangeable
- Automatic locking
- One-hand operation
- Full swivel action

STRAIGHT THROUGH

Full unrestricted flow. Same inside diameter as nominal pipe or supply hose. Sleeve action. Fast transfer of media.

- Full flow
- Leak-proof
- Sleeve action
- Rugged construction

DOUBLE SHUT-OFF

Shut-off valve in socket and plug stops the flow from both lines when disconnected. One-hand operation.

- PUSHOMATIC action
- Two-way check valve
- Automatic
- One-hand operation

All disconnects available from stock in various metals, end connections and sizes.

Write for Bulletin 1475.

PERFECTING SERVICE CO.
332 Atando Ave. Charlotte, North Carolina
Baltimore · Buffalo · Chicago · Cleveland · Camden · Los Angeles
New York · Providence · Montreal · Toronto · Canada

Circle 662 on Page 19

this
bearing gets 0.003 cubic inches of lubricant
every 15 minutes . . . automatically.
installation cost: $5.75 per bearing.

the frequency concept

in automatic lubrication

KEY TO:

lower maintenance costs / longer parts life

The frequent application of small, measured amounts of refinery-pure lubricant directly to bearings . . . that's the reason why automatic lubrication gives such remarkable savings in maintenance costs and such dramatic increases in parts life. The timeclock becomes the overseer of this precise operation. It triggers the charge of lubricant through main supply lines to the injectors that meter the exact amount to the individual bearings.

The highly polished bearing surface is always protected by a fresh supply of lubricant. It's little wonder that these precision parts stand up under constant high-speed service with a fraction of the wear shown by hand-lubricated bearings. The expensive result of improper lubrication comes with parts replacement. It isn't just the cost of the bearing . . . it's the labor time to replace it and the lost production!

Whether you build or buy machinery, you protect your investment with a dependable Lincoln automatic lubrication system.

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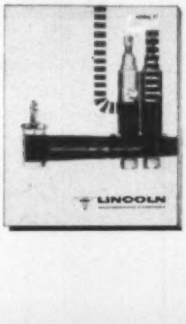
LINCOLN
ENGINEERING COMPANY

ST. LOUIS 20, MO. • DIVISION OF THE McNEIL MACHINE & ENGINEERING CO.



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☐ Please send me your new Catalog 82 on Lincoln centralized lubrication systems.

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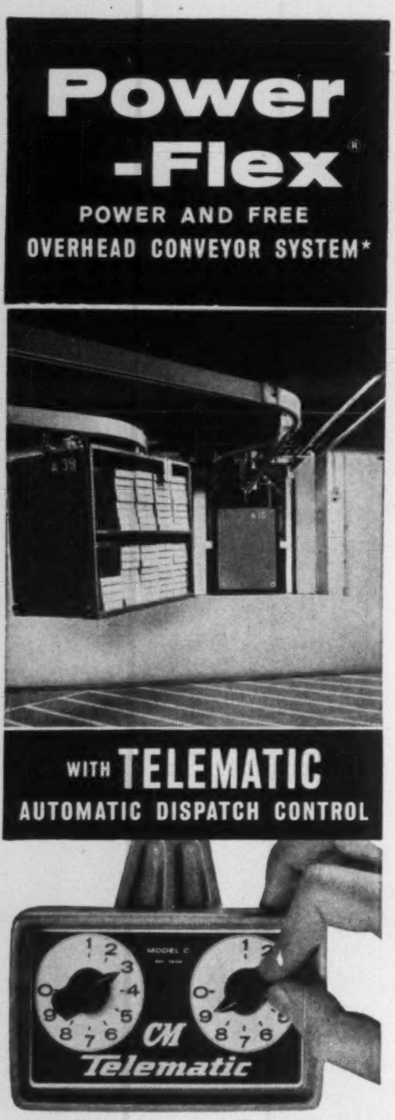
Firm__________
Address__________
City__________ Zone_____ State__________ 18103

Circle 663 on Page 19



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POWER AND FREE OVERHEAD CONVEYOR SYSTEM*

WITH **TELEMATIC**

AUTOMATIC DISPATCH CONTROL

• Simply set dials and Telematic guides carrier to any station in system

Employs exclusive unitized "over and under" power and free rail which permits simple switching to right or left as desired.

Power-Flex is designed for automated materials forwarding applications in industrial plants, distribution centers, service buildings and department stores. The most economical system available for loads up to 600 lbs. per carrier. Savings in actual installations range from 25% to 60%.

*Systems in service for your inspection.

Engineered to your very specific requirements.

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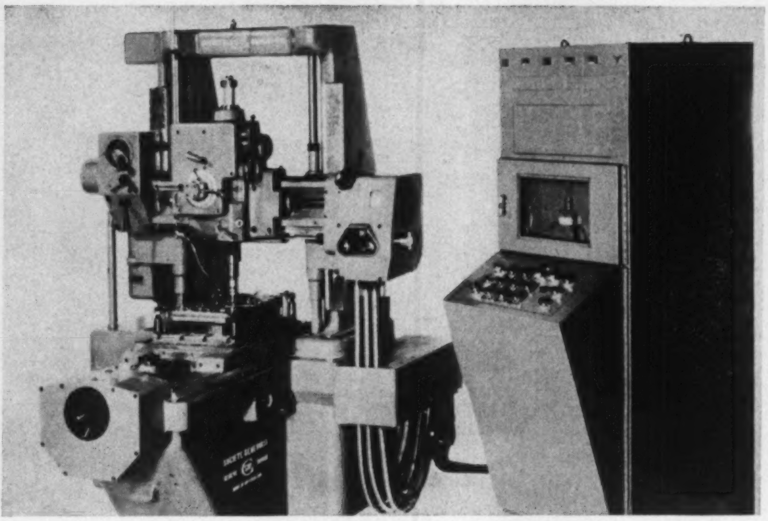
Inquiries from your engineers or consultants welcomed.

CM CONVEYORS

COLUMBUS McKINNON CORPORATION
Conveyor Division
TONAWANDA, N. Y.

Circle 664 on Page 19



NUMERICALLY CONTROLLED jig borer built by Societe Genevoise D'Instrument de Physique (SIP) has a guaranteed positioning accuracy of within 80 millionths of an inch. Automatic positioning of the table and spindle head is achieved by means of a punched tape which carries co-ordinate data in the form of information blocks for each positioning cycle. The tape-controlled program includes the automatic hydraulic unclamping, positioning, and reclamping of the table and the spindle head saddle. The numerical control equipment is built by Sperry Gyroscope Co. of Canada Ltd.

for electronic data processing systems. Eight regional offices have been established in major cities to direct computer marketing activities in 240 cities which have branch offices. . . . **Thompson Ramo Wooldridge Inc.** will construct a new Replacement Div. on a 55-acre site in Independence, Ohio. The division supplies more than 20,000 automotive part numbers through wholesale dealers to the auto repair industry. Estimated cost of the project is $3 million. . . . **Wellman Bronze and Aluminum Co.** has moved its plant facilities to a site in Bay City, Mich., formerly occupied by Dow Metal Products Co. The additional facilities will permit expansion in the aluminum and magnesium castings area. . . . **National Cylinder Gas Div., Chemetron Corp.** will build facility using a new process to provide liquid and gaseous oxygen and nitrogen at Roemer Works, Sharon Steel Corp.

MEETINGS AND EVENTS

July 4-7—
National Society of Professional Engineers. Annual meeting to be held Olympic Hotel, Seattle. More information available from society headquarters, 2029 K St., N.W., Washington 6, D. C.

July 16-21—
International Conference on Bio-Medical Electronics and Electronic Techniques in Medicine & Biology. Sponsored by AIEE, IFME, IRE, and ISA. To be held at Waldorf Astoria Hotel, New York. Further details available from IRE headquarters, 1 East 79 St., New York 21, N. Y.

July 17-21—
National Association of Power Engineers. National convention to be held Sheraton-Gibson Hotel, Cincinnati. Additional information from association headquarters, 176 W. Adams St., Chicago 3, Ill.

July 27-29—
Southern States Apprenticeship Conference. Cosponsored by Bureau of Apprenticeship and Training of U. S. Dept. of Labor with other groups. To be held Heidelberg Hotel, Jackson, Miss. More information available from Bureau of Apprenticeship and Training, U. S. Dept. of Labor, Washington 25, D. C.

July 31-Aug. 11—
Digital Control Systems Course. Two week summer course in digital control systems engineering will be held at Case Institute of Technology, Cleveland. More information available from Dr. Harry Mergler,

Case Institute of Technology, University Circle, Cleveland 6, Ohio.

Aug. 6—
Industrial Research Conference. To be held Arden House, Harriman, N. Y. by Columbia University. Information available from Mary Garvey, Industrial and Management Engineering Dept., Columbia University, New York 27, N. Y.

Aug. 14-17—
Society of Automotive Engineers. National West Coast meeting to be held Sheraton Hotel, Portland. Further details available from society headquarters, 485 Lexington Ave., New York 17, N. Y.

Aug. 14-18—
Gordon Research Conference on Instrumentation. To be held Colby Junior College, New London, N. H. Information available from W. George Parks, Colby Junior College, New London, N. H.

Aug. 15-18—
Technical Association of the Pulp and Paper Industry. Testing conference to be held Queen Elizabeth Hotel, Montreal, Que., Canada. Details available from association headquarters, 360 Lexington Ave., New York, N. Y.

Aug. 22-25—
Western Electronic Show and Convention. To be held Cow Palace, San Francisco. Information is available from WESCON, 1435 South La Cienega Blvd., Los Angeles, Calif.

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AUTOMATION

"He's our programming director."

MARK *delicate* PARTS WITHOUT MARRING OR DISTORTING SURFACES . . .

- CLEARLY
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AIRGRIT
MARKING MACHINE

Matthews Airgrit eliminates many marking problems. It may be the answer to yours.

Through inexpensive molded rubber masks, it will "blast-etch" trademarks, names or codes with lettering as small as .055" within a fraction of a second. Masks have surprisingly long life for economical marking.

Self contained unit needs only air source and electrical outlet for easy installation. Simple to operate, no special training required.

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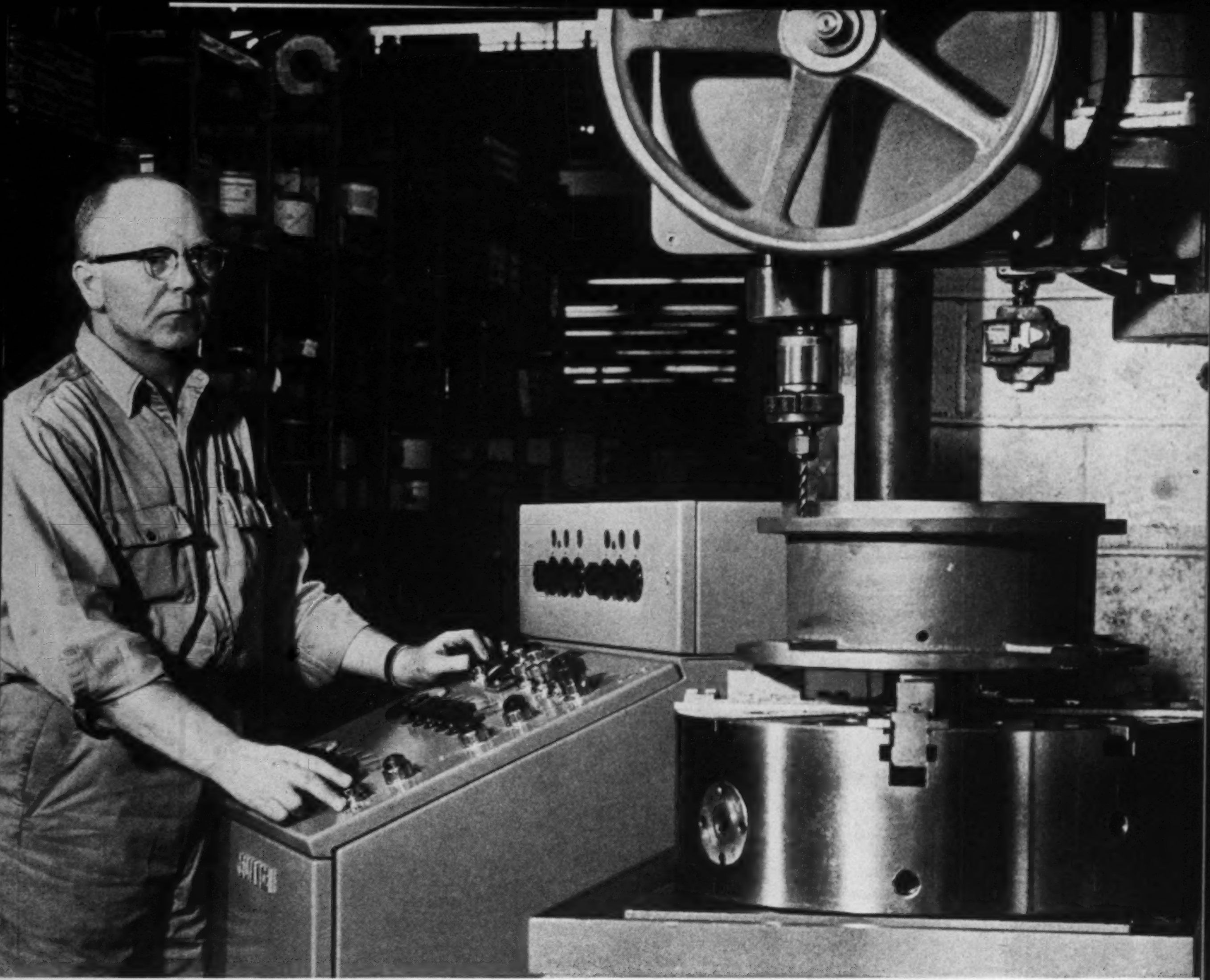


NEW RELIANCE SYSTEM FOR AUTOMATIC POSITIONING OF MACHINE TOOLS

This drilling machine is operated by Reliance Programmed Numerical Control. It cuts the costs of lead time and expensive tooling. It provides fast, highly accurate positioning . . . electrical accuracy of ± .0001 inch and repeatability of .00001 inch can be achieved. This is an absolute system operating from a fixed reference with no cumulative error.

The Reliance drive operates feed motors at high speed until position is approached. Motors are then slowed down in proportion to the distance from the programmed point, stopping at the exact position. Any number of linear or rotary motions can be controlled simultaneously or individually for complete automatic operation. Provision is also made for programming auxiliary functions, such as turret selection, clamping and coolant control.

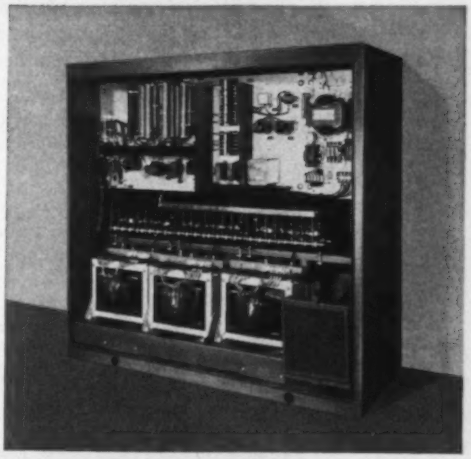
Reliance Programmed Numerical Control uses 8-channel machine tape or dial selector switches for input. Operates from standard tape processing and reading equipment.

It will pay you to get the complete facts about this equipment. Your Reliance Sales Engineer has all the information. Consult the Yellow Pages or write us direct.

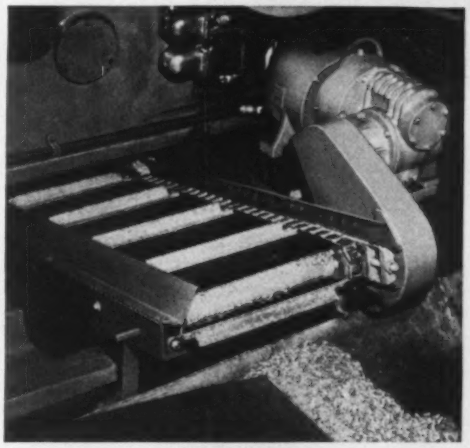
A-1686

RELIANCE...builders of the tools of automation

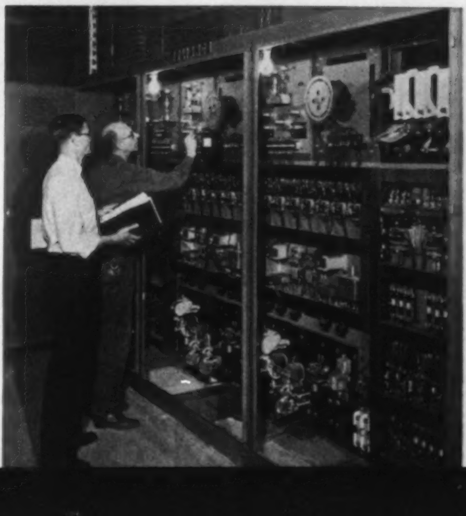
NEW DUTY MASTER D-5000 design brings you new standards in coolness, quietness . . . and more horsepower in less space. Frame dimensions that held 150 hp. now contain 300 hp. There is better heat dissipation from the frame itself. Air flows easily through the entire grilled end areas—exhausts through long, protected slots at the sides and bottom. New fingerless ducted rotor design means better cooling than any other previous motor. You get all famous Duty Master features in this new D-5000 . . . special lubrication design, drip or splash-proof and complete open motor protection. Bulletin B-2515.



RELIANCE V★S STATATRON is a static powered drive for wide range variable speed from in-plant a-c. circuits, available from 1 to 200 hp. Instead of a motor-generator set, the Statatron uses silicon diodes and saturable reactors to rectify the current from a-c. to d-c. These work in combination with a transistorized power exciter to supply variable voltage. Statatron is compact—35% smaller than conventional units. Consists of only three components: Super "T" d-c. motor, operator's station and control cabinet. Statatron is quiet—vibrationless and low in maintenance cost. Bulletin D-2508.



THIS MASTER GEARMOTOR drives a chip conveyor on an automatic screw machine. The combination parallel and right angle reduction produces efficient low output speed at high torque—ideally suited to this operation. Features important here are its compactness and one piece construction, saving space and maintenance. This Master Gearmotor is impervious to liquids . . . splashing of coolant and any other outside contamination. Where the situation calls for gearmotors, this full line can cut your engineering and assembly costs . . . give you dependable performance. Bulletin E-2409.



TOTAL SERVICE is an integral part of every Reliance product, from engineering and start-up assistance to maintenance and renewal parts. The photo shown here is typical of a Reliance Service Engineer's on-the-job availability—for maintenance and consultation on knotty problems. Every Reliance Sales Engineering Office and Distribution Center—nationwide—gives you the attention and experience necessary to assure the top performance you expect from the Reliance equipment you buy.

RELIANCE ELECTRIC AND ENGINEERING CO.

DEPT. 26-7, CLEVELAND 17, OHIO • Canadian Division: Toronto, Ont.

Circle 666 on Page 19

American Hoist

SAVES SIX HOURS PER WELDMENT

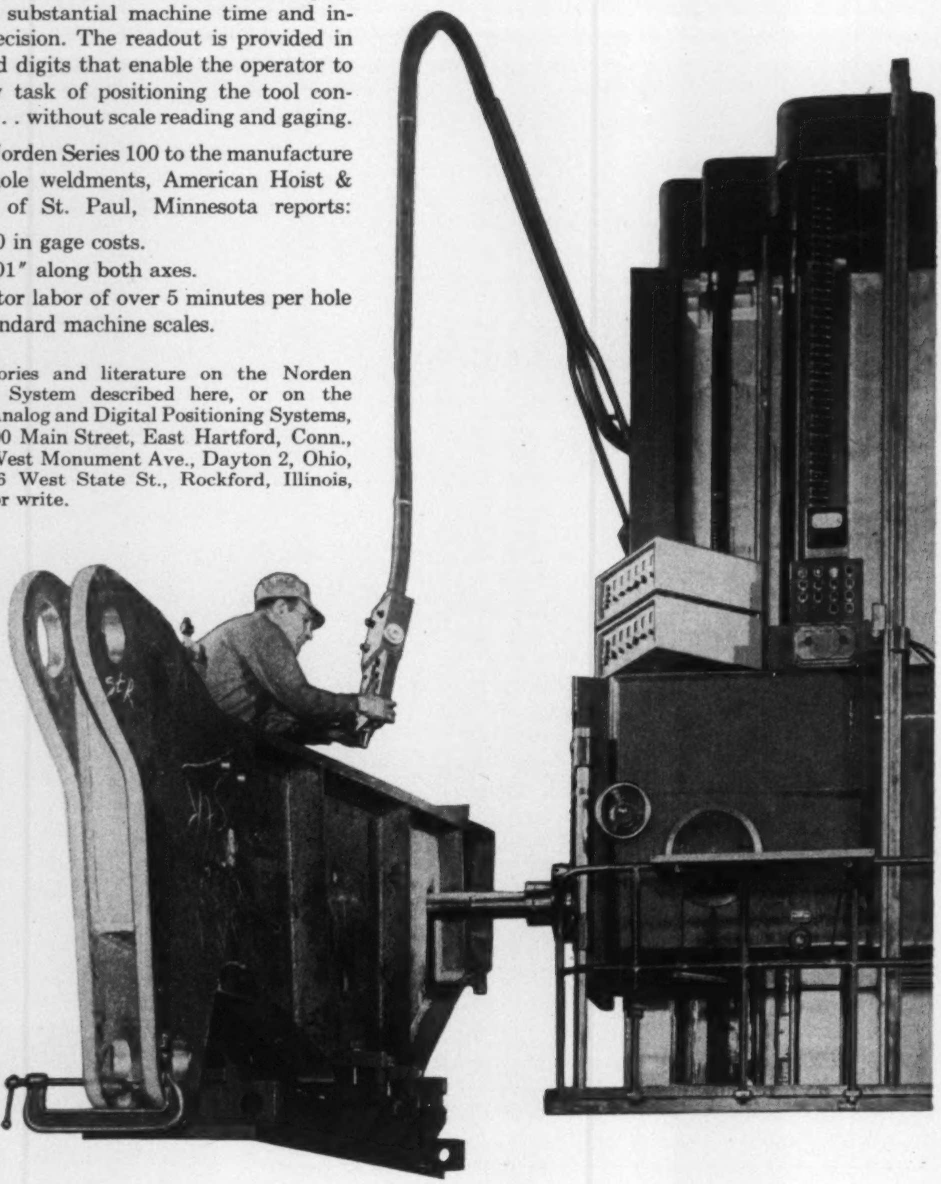
with Norden's Series 100 Modumatic Position Display System

American Hoist's costly, complex weldment structures must be precision bored along both sides of their 16-foot length. Equipping their 7″ Gray Boring Mill with two of Norden's Series 100 Modumatic Display Systems has saved substantial machine time and increased product precision. The readout is provided in six large illuminated digits that enable the operator to accomplish the key task of positioning the tool confidently, smoothly . . . without scale reading and gaging.

In applying the Norden Series 100 to the manufacture of these large 52-hole weldments, American Hoist & Derrick Company of St. Paul, Minnesota reports:

- Savings of $2,000 in gage costs.
- Accuracy to ±.001″ along both axes.
- Savings in operator labor of over 5 minutes per hole location over standard machine scales.

For other case histories and literature on the Norden Modumatic Display System described here, or on the Norden Modumatic Analog and Digital Positioning Systems, contact Norden at 400 Main Street, East Hartford, Conn., JAckson 8-4811; 11 West Monument Ave., Dayton 2, Ohio, BAldwin 8-4481; 206 West State St., Rockford, Illinois, WOodland 5-1891—or write.



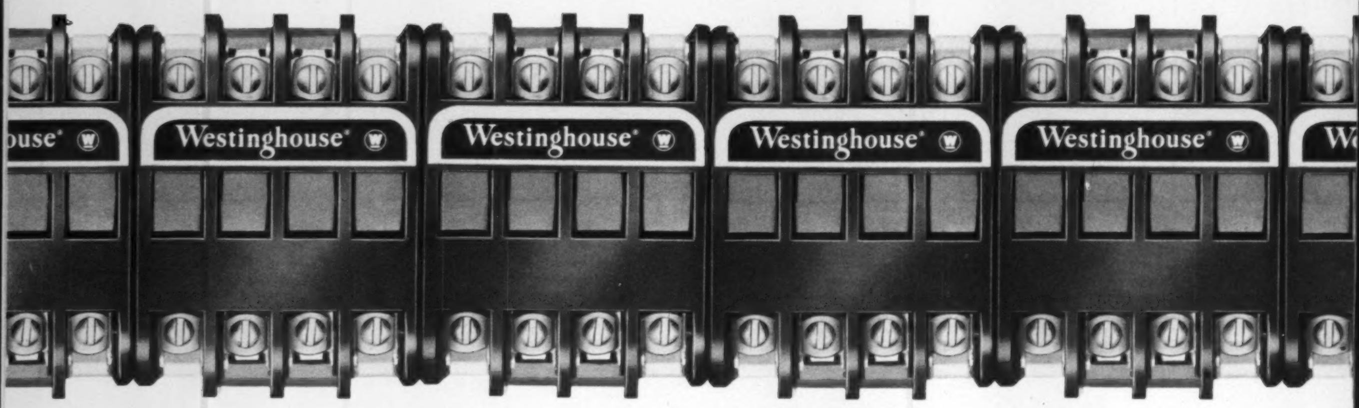
NORDEN division of UNITED AIRCRAFT CORPORATION

DATA SYSTEMS DEPARTMENT
3501 HARBOR BOULEVARD, COSTA MESA, CALIFORNIA

Circle 667 on Page 19

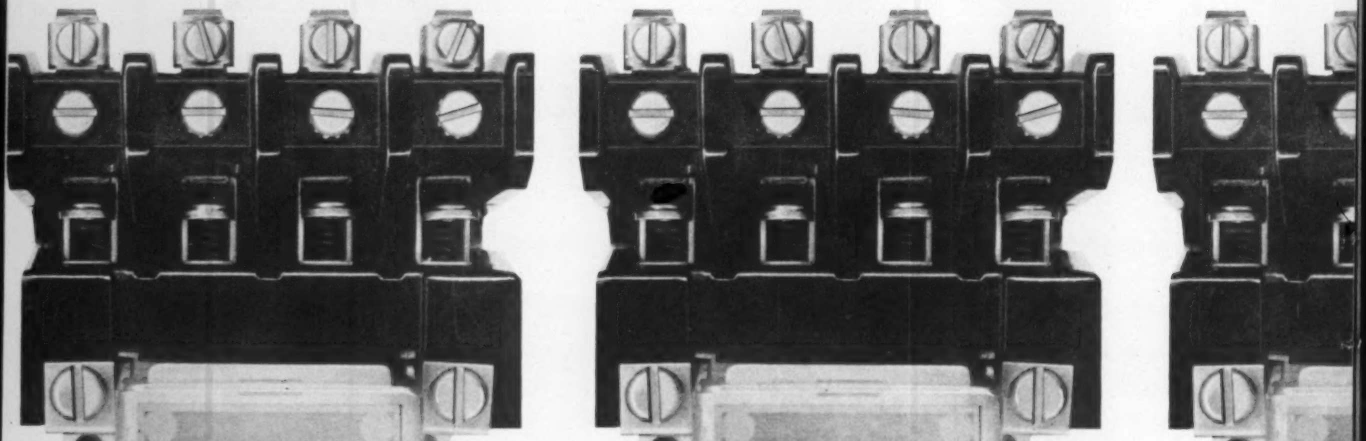
Circle 668 on Page 19→

New Westinghouse BF relay shrinks machine control relay panel space 33% to 78%


Westinghouse

See for yourself how many new Westinghouse BF relays

ALL PHOTOS ACTUAL SIZE



General characteristics of the Westinghouse BF relay

Dimensions
Without base plate: 1$\frac{11}{16}$" x 2$\frac{3}{8}$"
With base plate: 1$\frac{11}{16}$" x 3$\frac{1}{8}$"

Operating time
Pickup: 12.5 to 18.0 milliseconds
Dropout: 6.25 to 12.5 milliseconds

Relay can be operated manually to test circuits.

4 and 8 pole frames in any combination or normally open and normally closed contacts with a maximum of 4 normally closed.

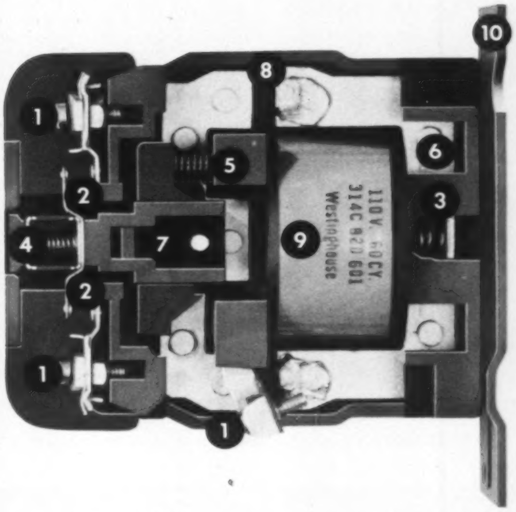
Contact rating—6 amps. 300 volts AC. 60 amperes inrush.

Relay can be mounted in any position on a vertical surface without changing operational characteristics.

The Westinghouse BF relay provides these features

- up to 78% less mounting space required
- front accessible
- can be butted without extra space for wiring
- quick coil and contact changes when needed
- low operating temperature
- lower installed cost
- long service life
- magnet and armature have specially hardened pole faces
- shorter operating stroke
- lightweight operating parts
- silver alloy contacts have built-in wiping action for prolonged circuit continuity

How the new Westinghouse design assures reliability and durability



EASILY WIRED

1. All connections are wired from the front with pressure clamp terminals.

OUTSTANDING CIRCUIT CONTINUITY

2. Proper contact wipe is built-in for long life of the silver alloy contacts and for positive circuit continuity.
3. Contact bounce is minimized by unique magnet suspension that eliminates shock and jar.
4. Automatic, positive alignment of crossarm insures simultaneous contact of all poles.

POSITIVE OPERATION

5. Stainless steel kickout springs permit any mounting position on a vertical surface — independent of gravity.

LONG MECHANICAL LIFE

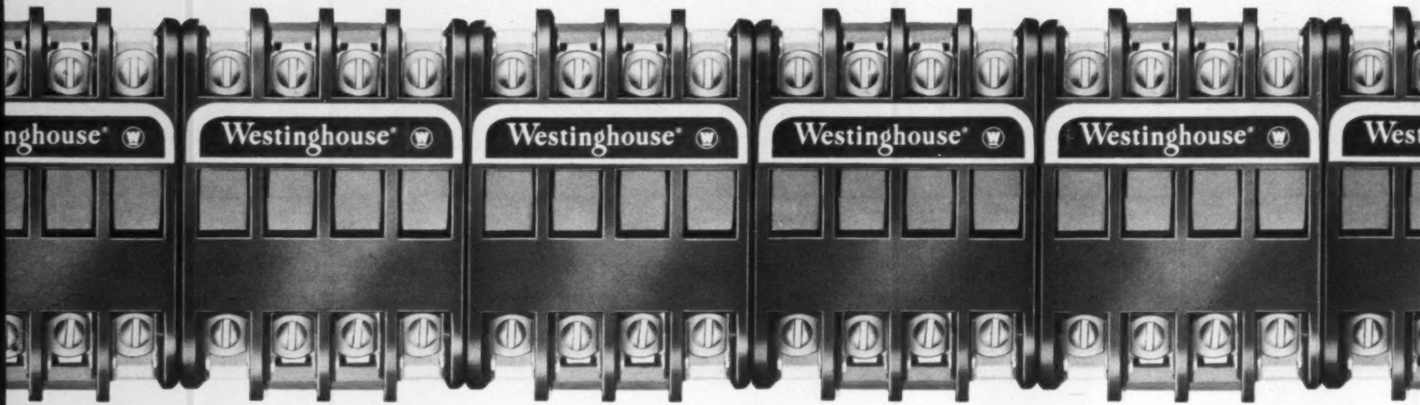
6. In addition to preventing contact bounce, the magnet suspension cushions the contact between armature and magnet, protecting entire unit from shock.
7. Low mass and short stroke, possible only with a small relay, save wear on every moving part.
8. Pole faces are surface hardened to maintain desired air gap.

MINIMUM POWER LOSS

9. Closed gap coil loss is only 3 watts for low coil operating temperature. Open coil burden 70 volt amps; closed, 11 volt amps.

EASE OF MOUNTING

10. Steel base has keyhole slots for rapid installation, extends only into wiring area to avoid space waste, and may be removed if desired.


nghouse
Westinghouse
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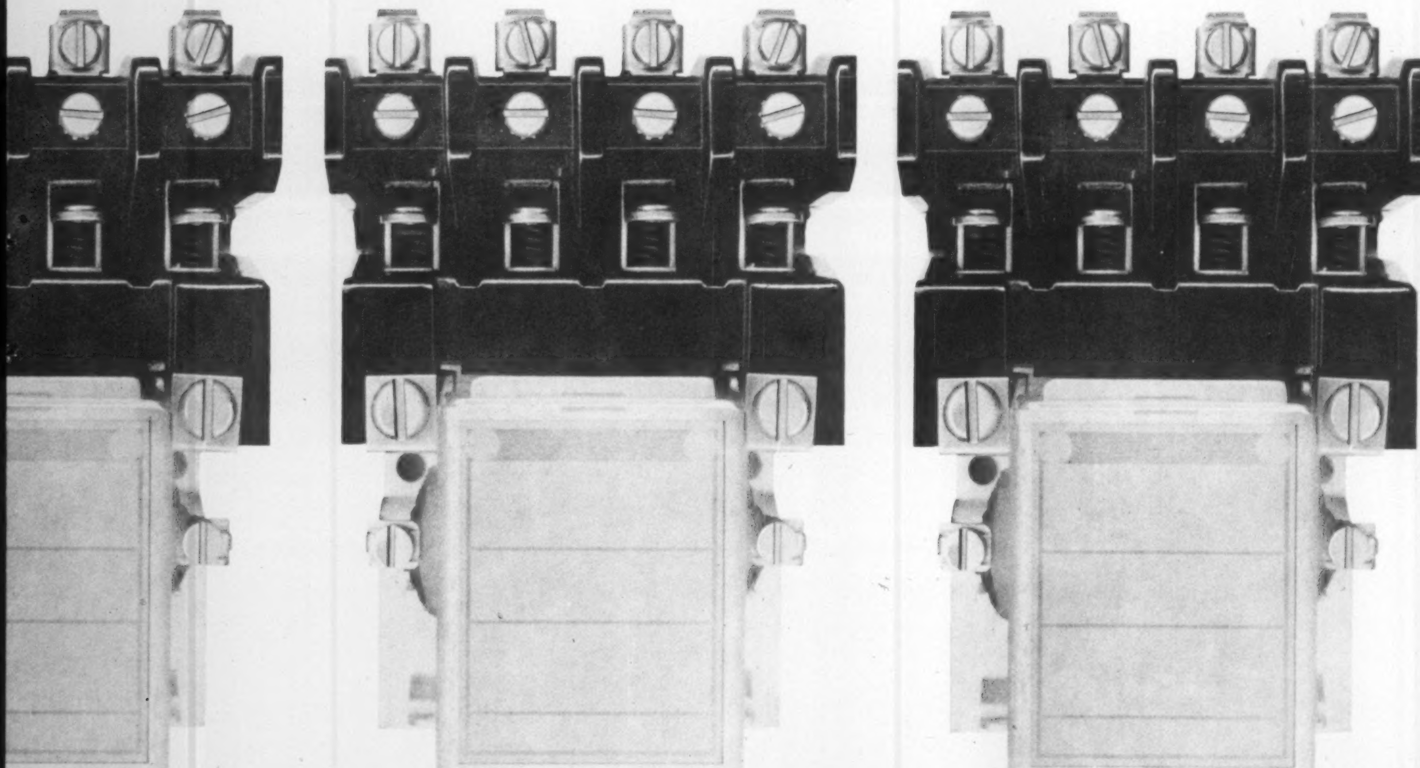
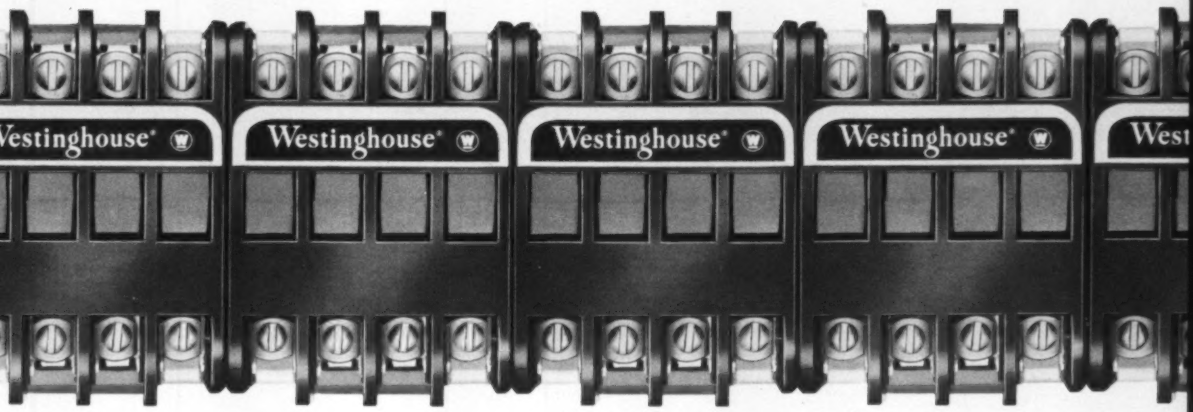
Wes

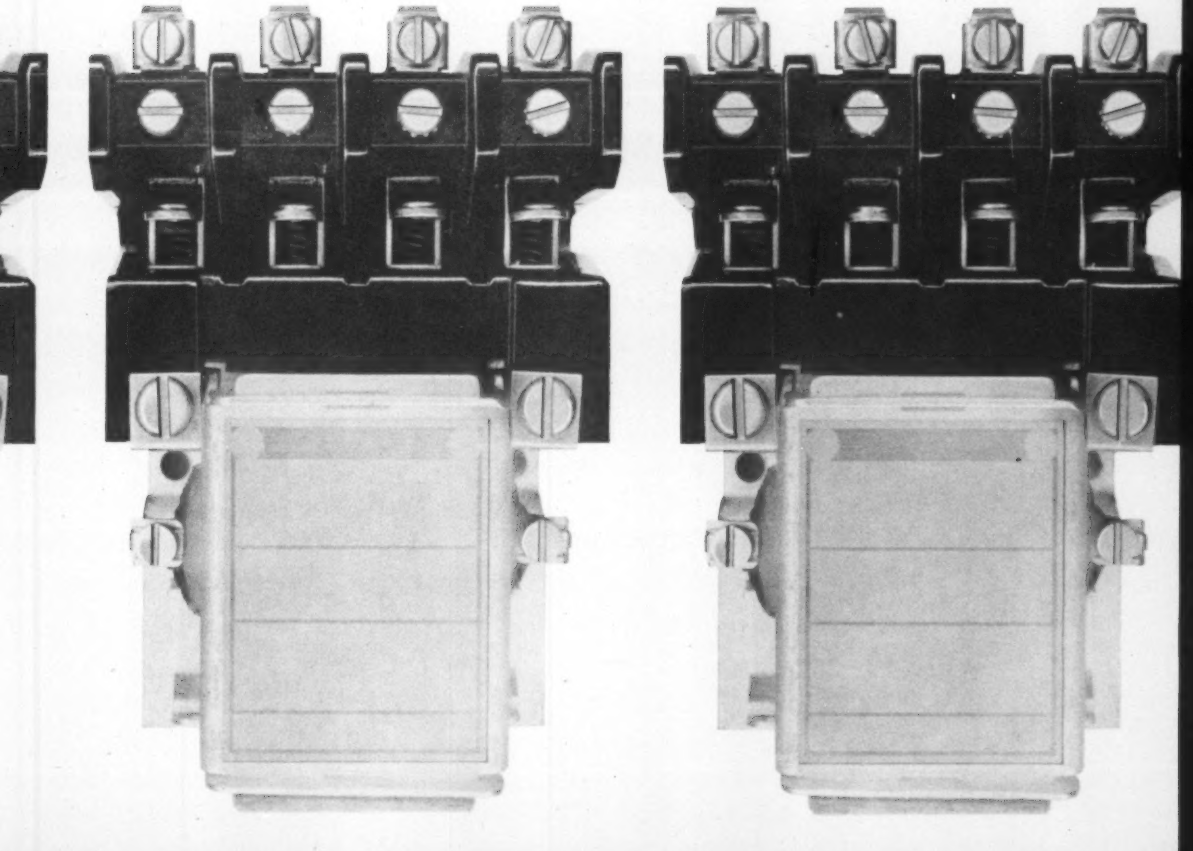
can fit in the same space as 7 conventional relays—this is hov



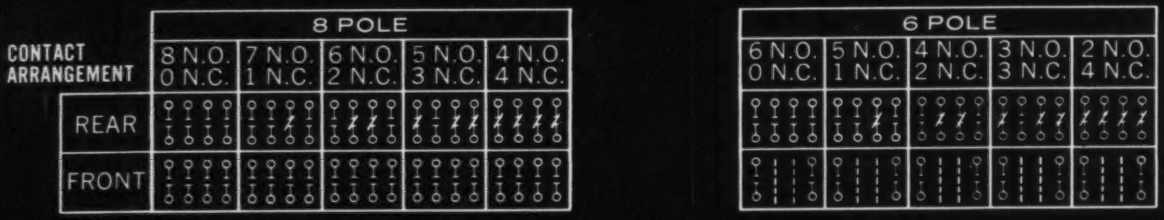

Westinghouse
Westinghouse
Westinghouse
Westinghouse
West

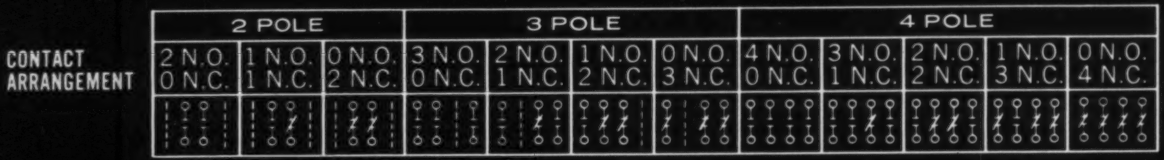
ow control panels can be reduced as much as 78%

You can be sure . . . if it's Westinghouse



BF relay contact information


8 POLE
CONTACT ARRANGEMENT
8 N.O. 0 N.C.
7 N.O. 1 N.C.
6 N.O. 2 N.C.
5 N.O. 3 N.C.
4 N.O. 4 N.C.
REAR
FRONT
6 POLE
6 N.O. 0 N.C.
5 N.O. 1 N.C.
4 N.O. 2 N.C.
3 N.O. 3 N.C.
2 N.O. 4 N.C.


CONTACT ARRANGEMENT
2 POLE
2 N.O. 0 N.C.
1 N.O. 1 N.C.
0 N.O. 2 N.C.
3 POLE
3 N.O. 0 N.C.
2 N.O. 1 N.C.
1 N.O. 2 N.C.
0 N.O. 3 N.C.
4 POLE
4 N.O. 0 N.C.
3 N.O. 1 N.C.
2 N.O. 2 N.C.
1 N.O. 3 N.C.
0 N.O. 4 N.C.

N.O.—Normally Open N.C.—Normally Closed

Westinghouse engineers have helped solve the design problem caused by the enlarged control panels needed to operate highly complex automated machine tools. The new Westinghouse BF Control Relay . . . although compact in size . . . has a rated full load current of 6 amperes at 300 volts AC. In new or modernized facilities, it *assures more productive capacity per square foot from every automated machine tool.*

Type BF—60 cycles

number of poles	contacts		open type catalog number
	normally open	normally closed	
2	2	0	BF20A
	1	1	BF11A
	0	2	BF02A
3	3	0	BF30A
	2	1	BF21A
	1	2	BF12A
	0	3	BF03A
4	4	0	BF40A
	3	1	BF31A
	2	2	BF22A
	1	3	BF13A
	0	4	BF04A
6	6	0	BF60A
	5	1	BF51A
	4	2	BF42A
	3	3	BF33A
	2	4	BF24A
8	8	0	BF80A
	7	1	BF71A
	6	2	BF62A
	5	3	BF53A
	4	4	BF44A

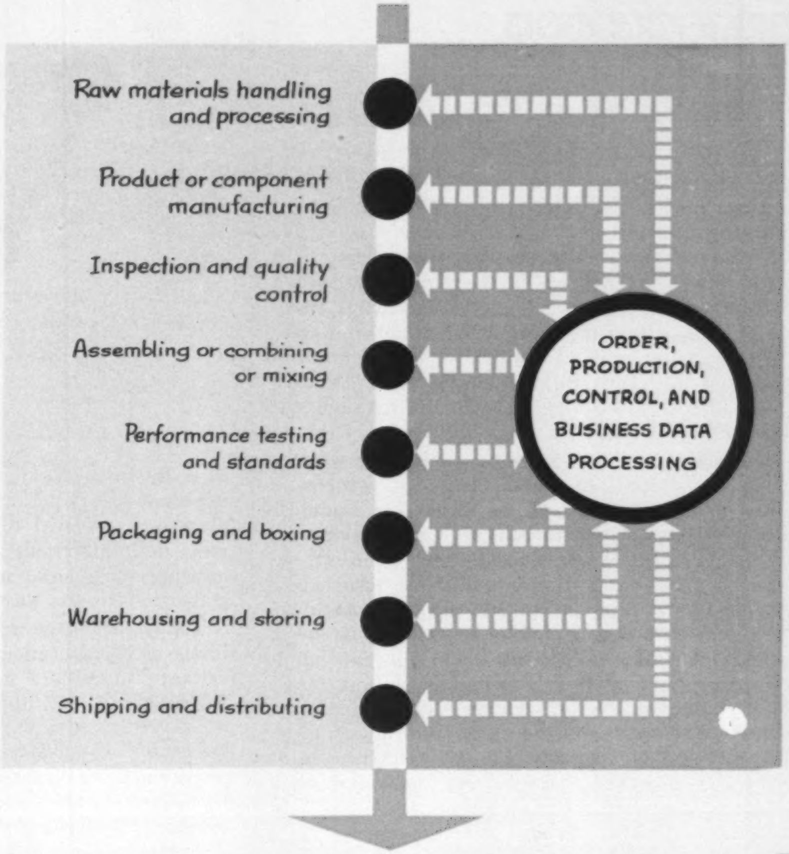
Ordering information

BF Relays are available direct through your nearest Westinghouse representative. When ordering be sure to specify the total number of poles desired, including the number of poles open and the number closed. Also specify coil control voltage and cycles. The chart at the left shows some of the most widely used relays with 110-volt, 60-cycle control voltage. Consult your Westinghouse representative about other BF Relays which are available. Or write Westinghouse Standard Control Division, Beaver, Pa.

You can be sure . . . if it's Westinghouse

J1-30323 1-

AUTOMATION


Raw materials handling and processing
Product or component manufacturing
Inspection and quality control
Assembling or combining or mixing
Performance testing and standards
Packaging and boxing
Warehousing and storing
Shipping and distributing
ORDER, PRODUCTION, CONTROL, AND BUSINESS DATA PROCESSING

SURVEY REPORT AND FORECAST ON

AUTOMATION TRENDS

By **ROGER W. BOLZ**, Publisher and Editorial Director

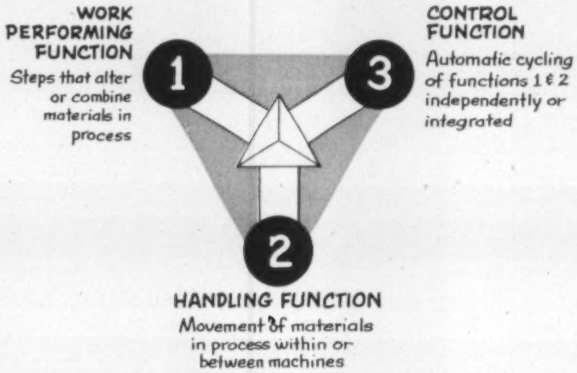
WITH THE gradual advance in the development and application of automation techniques throughout industry during the past decade, two highly significant trends have become apparent. One such trend is the demand for more complete manufacturing systems rather than various bits and pieces so as to achieve maximum processing efficiency unavailable otherwise. The second key trend to be noted is that concerning manufacturing equipment expenditures. Capital investment per employee has nearly doubled and the proportion of expenditures for new equipment in new plant and equipment investment has risen to 70 per cent of the total.

Admittedly, many factors have influenced these trends. However, most influential in the final analysis has been the development of automation techniques which invariably result in a considerable increase in the amount of machinery and equipment used. Advancing sophistication in manufacturing systems, in turn, has resulted in considerably increased equipment costs due in large part to the research and development engineering involved.

Stimulated mainly by growing competition in a world market as well as by the rapidly expanding horizons of technical and scientific knowledge, automation has opened the doors to a market in processing machinery, handing equipment, and control systems that will reach $6.8 billions in 1961. By 1970 it is anticipated the total expenditures for such systems will top $15 billions.

Being a technology rather than a specific state or mode or device, automation basically involves a broad systematic approach to the entire manufacturing problem. It involves study and development of the complete manufacturing system in all its aspects. As a result, translation of the results into useable hardware on a realistic, economic basis results in systems of or including widely varying levels of technological sophistication. On the one hand, some processes lead directly to thoroughly integrated, automatically controlled systems due to necessity. There are processes, on the other hand, found to be uneconomical or impractical to develop into automatically controlled systems. In these instances, economic and competitive circumstances lead to development of new, perhaps simpler and certainly more economically practical methods and systems. Even new methods of control can lead directly to development of new methods of processing automatically through research stimulus.

Study of manufacturing systems resolves itself into eight fundamental segments: 1. Raw Materials Handling and Processing. 2. Product or Component Manufacturing. 3. Inspection and Quality Control. 4. Assembling or Combining or Mixing. 5. Performance Testing and Standards. 6. Packaging and Boxing. 7. Warehousing and Storing. 8. Shipping and Distributing. Within the system finally evolved three basic functional phases are carefully integrated


WORK PERFORMING FUNCTION
Steps that alter or combine materials in process
1
CONTROL FUNCTION
Automatic cycling of functions 1 & 2 independently or integrated
3
2
HANDLING FUNCTION
Movement of materials in process within or between machines

in order to insure a working system. These three functions—work performing, handling, and control—must be considered together in order to secure the most desirable results. Actually, it is a matter of creating three basic subsystems which function together to form the master system.

Today, automatic manufacturing systems on many levels of sophistication are being developed. Consultants, machinery builders, automation engineering specialists, and in-plant manufacturing engineers are active in this work. Assisting them in the development of necessary subsystems in process equipment, handling, and control are an expanding variety of manufacturers and specialists throughout the country. This third AUTOMATION study of trends in industry documents a large portion of this activity.

The highlights of the results of this study of over 18,000 establishments are presented in this report. Most significant perhaps in the data outlined is the planned capital investment figures for 1961. Actual figures reflecting early plans for 1961, when adjusted to include advances that have taken place since, indicate the total for the year will finally reach a figure considerably in excess of the Forecast made in January.

Details of this study reveal a promising picture. However, much work is yet to be done. Significant results in applying automation technology are not easily achieved. There is considerable research yet to be done. Most important is the fact that few industries are seriously engaged in continuing manufacturing research and development. Nevertheless, until manufacturers recognize the need for such R&D, advance will continue to be slow and new breakthroughs in manufacturing techniques severely restricted.

Looking ahead, it has been said that American industry will invest more in new capital equipment in the sixties than in the previous three decades. This investment can be no mere replacement program. World competition and advancing technology dictate it must be a significantly new and unique attack on the problems at hand. Broad and intensive programs for manufacturing research and development along with practical application of automation techniques will create an advance far beyond anything yet seen.

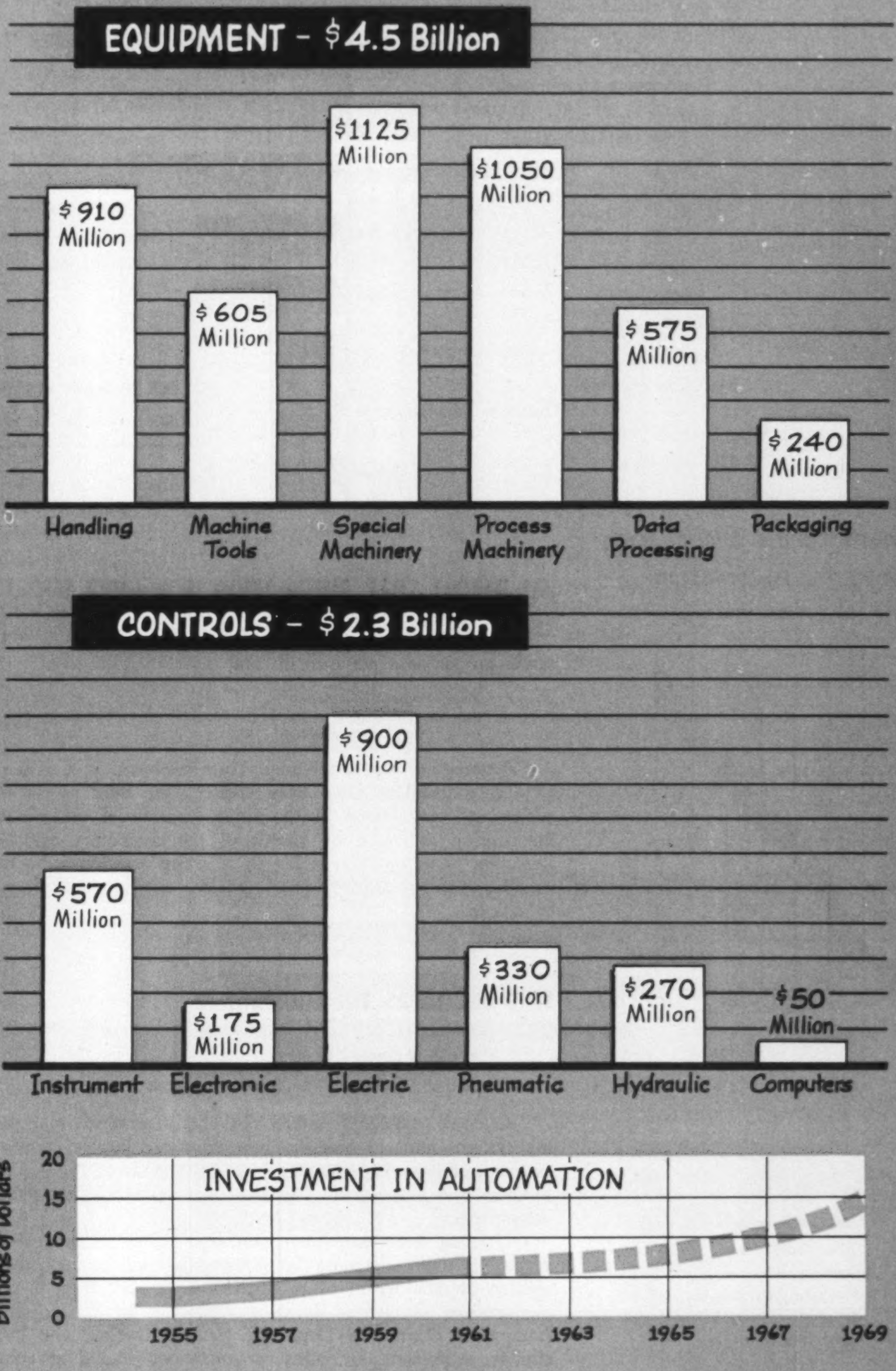
FORCES COMPELLING AUTOMATION

1. International Technological Competition
2. Demand for Higher Living Standards
3. Pressure of Population Increase
4. Expanding Horizons of Scientific Knowledge

ADDITIONAL FORCES:

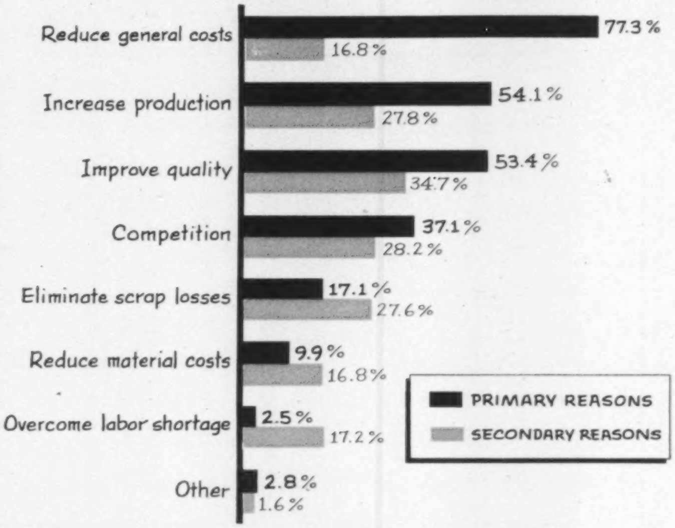
1. Rising Capital and Overhead Costs
2. Need for Higher Product Quality and Uniformity
3. Increased Manufacturing Competition
4. Added Business Volume and Complexity

AUTOMATION MARKET FORECAST FOR 1961



WHY INDUSTRY LOOKS TO MORE AUTOMATIC MANUFACTURING AND DATA PROCESSING FACILITIES

As Reported (1808 companies)



ALL REPORT THAT AUTOMATION IS A JOINT EFFORT

(2274 Plants Reporting)

Responsibility and direction is lodged primarily in 3 functional groups as a per cent of total individuals involved:

Manufacturing Engineering	**59.4%**
Production Executive	**22.1%**
Administrative Management	**18.5%**

Automation has raised many new problems and as a result new responsibilities have been created, the most important of which are now found in the basic function of manufacturing engineering indicated by 75.9% of the companies responding. Direction of automation is largely a group activity, some formal organizations comprising many individuals from the foregoing categories.

WHO ENGINEERS THE EQUIPMENT?

(1820 Plants Reporting)

83.7%	**Engineered by User**
68.5%	**Engineered by Equipment Builders**
30.0%	**Engineered by Engineering Specialists**

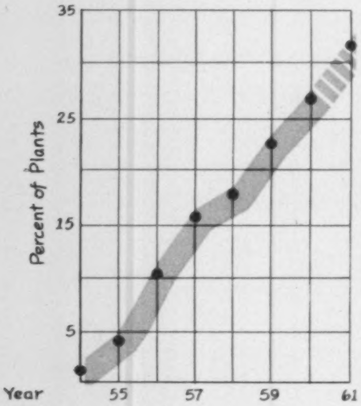
Over-all engineering planning of automated manufacturing systems must of necessity be carried out largely by the particular manufacturer. Once the system is evolved, the equipment builders and engineering specialists are called on for detail developments.

Quoting one prominent consumer products manufacturer regarding today's trends, "Well over 90 per cent of the two million dollars' worth of production equipment now in use in our modern plant was designed and built by the Mechanical Equipment Dept. The Dept. will design, develop, and produce similar equipment for other organizations including complete automatic production lines, automatic processing equipment, and semiautomatic assembly machinery."

86.8%
of equipment builders
report buyers
ask for automatic
devices and
equipment

Growth Trend in Manufacturing Engineering Groups for Automation

(2418 plants reporting)



95%
of equipment
builders seek
to reduce customers
processing costs with
automatic devices
and equipment

PLANTS HAVING SPECIAL AUTOMATION GROUPS

(% of 2418 Plants Reporting)

SIC	Industries	% 1960	% 1958	% Plan for 1961
20	Food products	13.7	6.0	6.2
21	Tobacco	20.0	—	—
22	Textiles	18.1	7.3	5.5
23	Apparel and fabrics	16.7	12.5	—
24	Lumber and wood	28.0	6.1	4.0
25	Furniture and fixtures	43.3	14.8	—
26	Paper	27.7	10.7	—
27	Printing and publishing	40.0	12.1	3.3
28	Chemicals	26.1	20.7	4.8
29	Petroleum	40.4	33.3	2.2
30	Rubber products	23.2	12.5	—
31	Leather products	13.6	16.7	—
32	Stone, clay and glass	25.2	8.9	3.7
33	Primary metals	22.6	11.4	6.7
34	Fabricated metals	21.0	10.3	5.3
35	Machinery (except electrical)	23.5	15.8	4.6
36	Electrical machinery	34.9	28.4	6.4
37	Transportation	31.7	25.5	1.0
38	Instruments	28.6	27.9	4.7
39	Misc. Mfg.	19.0	20.7	3.4
8911	Engineering services	41.9	33.5	5.6
	All others	36.5	—	1.6

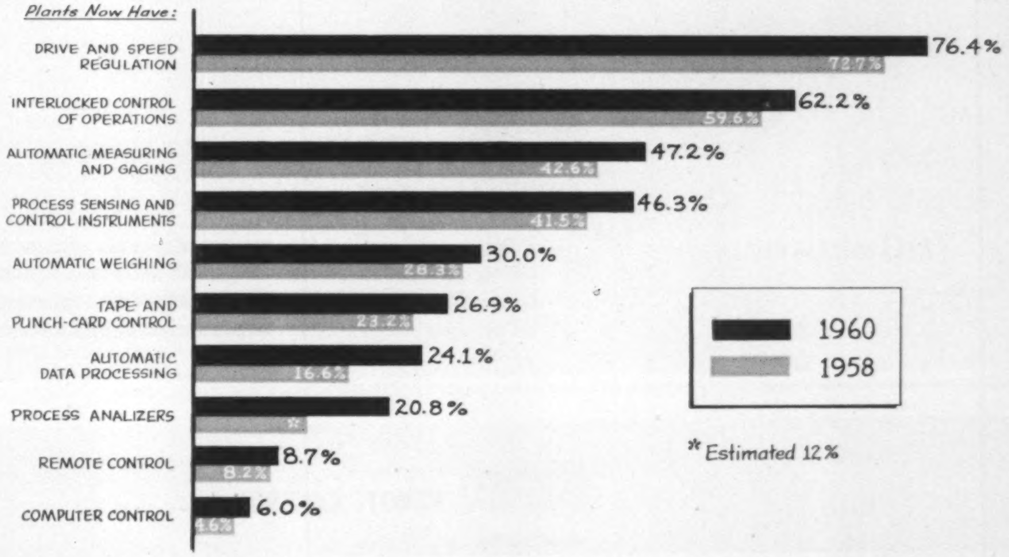
OPERATIONS THEY PLAN TO MAKE MORE AUTOMATIC IN 1961

(1834 Plants Reporting)

% Now Used	Operation	% Planned for 1961
30.5	Assembly	20.4
5.7	Calendering, sheeting	2.3
6.6	Casting, forging, rolling	3.9
20.7	Cutting, shearing, forming	10.0
18.8	Data processing	11.2
16.8	Filling, closing	8.7
23.1	Finishing, painting, coating, plating	10.8
45.7	Handling, conveying, transferring	25.6
26.0	Heating, baking, heat treating	11.2
13.4	Inspection	12.1
20.3	Machine tools	11.6
12.2	Machine tools, automatic load & unload	10.8
4.1	Machine tools, tape and card control	6.9
10.7	Molding, extruding	6.9
20.9	Packaging, bundling	14.6
7.2	Plating, polishing	3.8
26.0	Processing machinery	15.6
16.5	Production, inventory control	14.8
17.7	Stamping, drawing	8.2
9.5	Storage, feeding, sorting	8.1
14.4	Testing	9.7
7.1	Warehousing	6.1
15.2	Washing, cleaning, conditioning	6.7
3.7	Weaving, sewing, stitching	1.8
26.8	Weighing, mixing, blending	15.6
11.7	Welding, riveting, fastening	7.1
10.8	Winding, coiling	5.3
3.8	Other	2.1

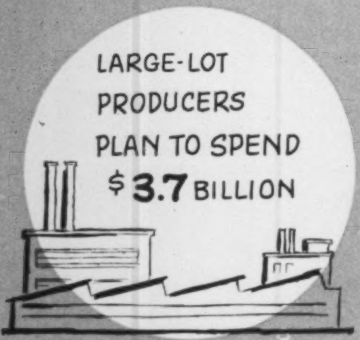
APPLICATION OF AUTOMATIC EQUIPMENT AND CONTROLS

(2,713 Plants Reporting)



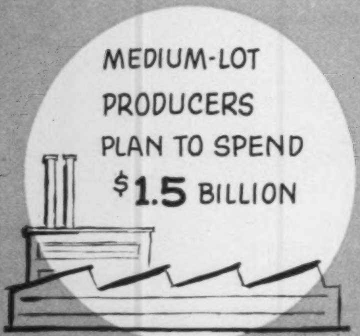
1961 AUTOMATION PLANS

(18,065 Plants)



LARGE-LOT PRODUCERS PLAN TO SPEND $3.7 BILLION

Average Per Plant
$619,000



MEDIUM-LOT PRODUCERS PLAN TO SPEND $1.5 BILLION

Average Per Plant
$237,000

SMALL-LOT PRODUCERS PLAN TO SPEND $780 MILLION

Average Per Plant
$202,000

LOT NOT GIVEN-$296 MILLION
Average Per Plant
$456,000

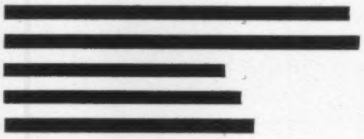
TYPES OF AUTOMATIC EQUIPMENT

46.4% Plan More (76.4% Now Have)

DRIVE & SPEED REGULATION

Analysis by type or use:

% Now Have		% Plan More
88.2	Mechanical	45.1
83.3	Electrical	46.1
54.5	Hydraulic	28.4
54.3	Pneumatic	30.6
48.5	Electronic	32.3



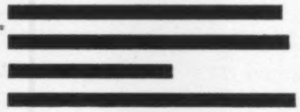
2106 Plants Reporting

30.0% Plan More (47.2% Now Have)

AUTOMATIC MEASURING & GAGING

Analysis by type or use:

% Now Have		% Plan More
68.6	Mechanical	35.7
58.1	Electrical	36.0
31.8	Pneumatic	21.2
44.9	Electronic	36.9



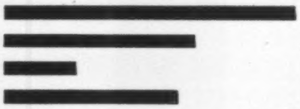
1373 Plants Reporting

17.7% Plan More (30.0% Now Have)

AUTOMATIC WEIGHING

Analysis by type or use:

% Now Have		% Plan More
77.6	Mechanical	37.5
38.8	Electrical	24.6
12.3	Pneumatic	9.3
23.3	Electronic	22.1



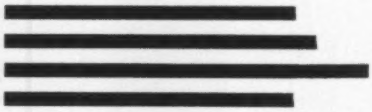
901 Plants Reporting

18.0% Plan More (24.1% Now Have)

AUTOMATIC DATA PROCESSING

Analysis by type or use:

% Now Have		% Plan More
52.3	Orders	37.7
53.7	Production planning	40.0
61.3	Inventories	46.9
33.6	Operations	36.9



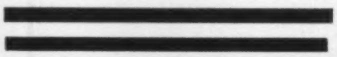
780 Plants Reporting

10.8% Plan More (8.7% Now Have)

REMOTE CONTROL

Analysis by type or use:

% Now Have		% Plan More
25.5	Telemetering	42.1
38.2	Data logging	41.5



306 Plants Reporting

AND CONTROLS THEY PLAN TO BUY

(2713 PLANTS REPORTING)

38.2% Plan More (62.2%. Now Have)

INTERLOCKED CONTROL OF OPERATIONS

Analysis by type or use:

% Now Have		% Plan More
63.0	Mechanical	35.3
86.3	Electrical	50.9
32.4	Hydraulic	19.9
43.1	Pneumatic	26.7
42.8	Electronic	31.9

1732 Plants Reporting

29.1% Plan More (46.3% Now Have)

PROCESS SENSING & CONTROL INSTRUMENTS

Analysis by type or use:

% Now Have		% Plan More
52.8	Pneumatic	31.3
77.3	Electrical	45.9
59.6	Electronic	42.1
16.7	Nuclear & X-ray	11.9

1308 Plants Reporting

20.0% Plan More (26.9% Now Have)

TAPE & PUNCH-CARD CONTROL

Analysis by type or use:

% Now Have		% Plan More
18.0	Production machines	25.9
8.8	Process equipment	14.6
78.4	Office machines	48.0

852 Plants Reporting

11.2% Plan More (20.8% Now Have)

PROCESS ANALYZERS

Analysis by type or use:

% Now Have		% Plan More
37.2	Plant on-stream	29.2
83.1	Laboratory	39.5

590 Plants Reporting

6.9% Plan More (6.0% Now Have)

COMPUTER CONTROL

Analysis by type or use:

% Now Have		% Plan More
40.5	Production process	16.7
9.3	Pilot plant	10.9
31.5	Machines	35.8

257 Plants Reporting

1961 AUTOMATION PLANS

(18,065 Plants)

●

TOTAL PLANNED INVESTMENT

$6,290,442,620

●

DISTRIBUTION BY TYPE OF MANUFACTURE

SMALL LOT	12.4%
MEDIUM LOT	24.3%
LARGE LOT	58.6%
NOT INDICATED	4.7%

●

INVESTMENT COMPARISON WITH 1960

GREATER	51.4%
SAME	27.2%
SMALLER	18.5%
NOT INDICATED	2.9%

●

EQUIPMENT BUILDERS

EQUIPMENT BUILDERS REPORT:

WHO DEVELOPS FEEDING AND HANDLING DEVICES?

Do-it-themselves	81.3%
Feeder builders	21.9%
Handling specialists	13.7%
Engineering specialists	18.2%

EQUIPMENT BUILDERS REPORT:

WHO DEVELOPS MACHINE AND PROCESS CONTROL SYSTEMS?

Do-it-themselves	82.4%
Control builders	21.8%
Engineering specialists	23.3%

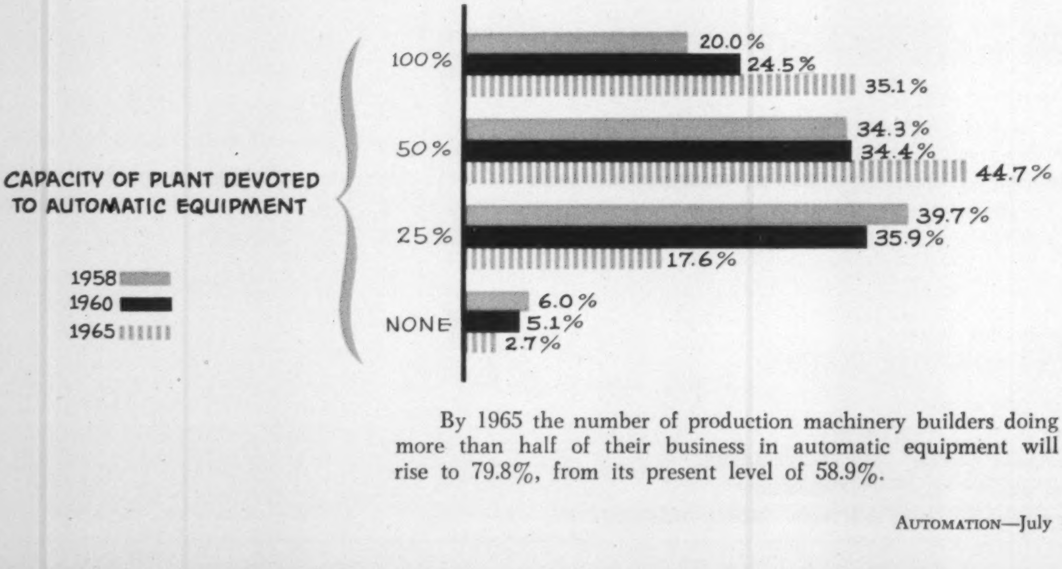
EQUIPMENT DESIGN AND BUILD ACTIVITY

	% of Companies Reporting
Assembly	42.0
Calendering, sheeting	4.4
Casting, forging, rolling	5.9
Cutting, shearing and forming	19.5
Data processing	10.3
Filling, closing	16.6
Finishing, painting, coating & plating	13.8
Handling, conveying, transferring	47.7
Heating, baking and heat treating	15.9
Inspection	18.5
Machine tools	27.4
Machine tools, automatic loading & unloading	27.2
Machine tools, tape or card control	8.0
Molding, extruding	7.5
Packaging, bundling	22.3
Plating, polishing	3.8
Processing machinery	29.7
Production & inventory control	5.9
Stamping and drawing	15.4
Storage, feeding and sorting	15.1
Testing	23.0
Warehousing	7.4
Washing, cleaning, conditioning	10.5
Weaving, sewing, stitching	4.1
Weighing, mixing and blending	19.2
Welding, riveting and fastening	13.3
Winding, coiling	12.5
Other	9.2

(610 Plants Reporting)

58.9% REPORT OVER HALF THEIR BUSINESS IS FOR AUTOMATIC EQUIPMENT *(549 Plants Reporting)*

Demand for more automatic operations throughout industry has increased the volume of business for builders of automatic equipment. This chart shows the present and anticipated portion of their business in this category. Some 64.5% of the builders indicate business has been increasing over former years.



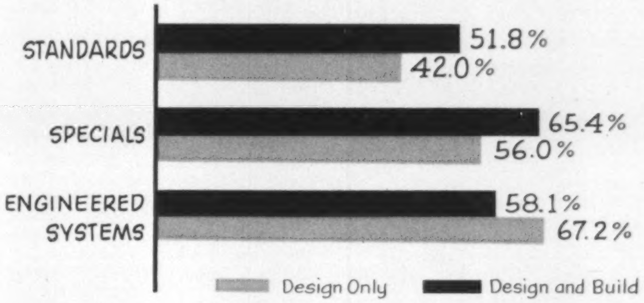
By 1965 the number of production machinery builders doing more than half of their business in automatic equipment will rise to 79.8%, from its present level of 58.9%.

COMPONENT BUILDERS

TREND IS TOWARD SYSTEMS

Responding to questions regarding their primary categories of operations, designers and builders of components for automatic equipment strongly indicate the present trend is more toward highly engineered drive and control systems. Because of the highly complex nature of automatic control systems for automated manufacturing equipment, there is also a strong trend to special components. Much of this influence can be attributed to the highly specialized one-of-a-kind nature of automatic production machinery and the necessary dependence on drive and control specialists for engineering of the integrated system. Responses included 128 companies that design only while 332 design and build.

SYSTEM TREND REPORTED BY DESIGNERS AND BUILDERS



66.3% of automatic equipment manufacturers indicate users influence selection of primary drives, controls and other purchased parts

83.6% of component builders indicate users influence selection of individual system components

COMPONENT DESIGN AND BUILD ACTIVITY

	% of Companies Reporting
Computer controls	21.8
Communications equipment	14.4
Dimensional controls	18.7
Electrical controls	54.7
Electronic controls	46.8
Hydraulic components	34.7
Instrument controls	33.2
Lubrication systems	11.6
Mechanical controls	39.7
Motor controls	27.1
Motors	9.4
Nuclear & X-ray controls	4.3
Numerical controls	14.9
Pneumatic components	25.3
Process analyzers	7.8
Process control equipment	31.9
Program controls	22.0
Test & inspection devices	30.9
Visual & audible devices	13.7
Weight controls	13.9
Other	7.3

(395 Plants Reporting)

SPECIFIC AUTOMATION PLANS

In this study Automation asked what manufacturing facilities would be automated in the next five years and what new devices were being developed particularly for automation needs. The intensely interesting and significant comments in reply to these two questions are listed by SIC groups in the following. Breadth of development and long-range trends in manufacturing automation are implicit in these verbatim comments.

SIC 20—FOOD AND KINDRED PRODUCTS

Equipment

Raw material processing . . . Concentrator units . . . New packaging lines . . . All packaging . . . Bulk flour handling, perhaps sugar . . . Perhaps some shipping . . . Several . . . Many process operations . . . Bulk handling of dry materials . . . All weighing, mixing and blending . . . Packaging . . . Processing, filling and packaging . . . Baking, peanut butter handling, raw peanut handling . . . Automation of boxing of all smoked meat products . . . Conveying and handling . . . Most all phases of manufacturing . . . Processing (extraction), waste removal, drying and all material handling (complete plant automation is planned) . . . Meat cutting and processing . . . Material handling . . . Packaging . . . Packing . . . Flour handling, bulk . . . Sugar handling, bulk . . . Syrup handling, bulk . . . Packaging, processing, office work . . . Packaging, manufacturing, palletizing . . . Can handling, supplies, processing . . . Packaging, handling and processing facilities . . . Cleaning storage tanks and tankers . . . Carton casing . . . Case stacking . . . Processing machinery . . . Cartoning, unloading and packing of cases . . . Packing, cooking, freezing and other processing operations . . . Syrup handling . . . Processing, can handling, bakery . . . Mixing, blending, filtering . . .

Container inflow, handling of unpackaging . . . six-pack bottle packaging . . . case stacking and stock handling . . . Liquid raw material handling to be extended . . . Additional production lines for producing, filling, closing and casing food products . . . Storing, warehousing . . . Bulk handling . . . Additional automation of other plants will be carried out dependent upon the success of the plant now under construction . . . Product handling and processing . . . Material handling, warehousing . . . Certain types of packaging, processing unit processes . . .

Handling, palletizing and conveyors . . . Press feeds . . . Can end handling systems . . . Full flow . . . Warehousing, weighing (batch) . . . Process conveying . . . Production and packaging . . . Part of processing equipment . . . Filling cases, stacking cases, wrapping ice cream, warehouse conveyor . . . Automatic canning for P.S. hams . . . Automatic ham grading . . . Automatic loin grading and packing . . . Packing, stamp application . . . Manufacturing high-speed conveying and transferring equipment . . . Processing . . . Coffee handling . . . Bulk flour handling . . .

Mainly processing and packaging . . . Packaging and warehousing . . . Mixing and blending . . . Equipment clean up—C.I.P. . . . Accounting and data processing . . . Boiler plant operations . . . Direct fired burners on spray dryers automatically controlled and protected . . . Several in-plant baking units plus a few complete plants . . . Packing equipment . . . Mixing equipment, packing and loading . . . Processing . . . Warehousing . . . Grain handling, filling, packaging . . . Food process control and data processing relating to operations and sales . . . Check weighing, packaging, mixing, finished goods handling . . . Production processes . . . Office records . . . Steam and fluid processing . . . Improved packaging, weighing and processing equipment . . . Handling equipment . . . Processing equipment . . . Batch weighing and automatic inventory control system . . . Miscellaneous mixing processes . . . Weighing, freezing, packaging . . . Conveying, measuring, warehouse order picking . . . Packaging, cooking . . . Bottling plant . . . Packaging and palletizing . . . Centrifugals . . . Melters, mixers, filtering presses, clarifiers, evaporators . . . Additional bottling equipment and some processing equipment . . . Some in all departments . . . Processing, packaging, testing . . .

SIC 21—TOBACCO MANUFACTURERS

Equipment

All possible . . .

SIC 22—TEXTILE MILL PRODUCTS

Equipment

Production and packing and sorting . . . Dye equipment . . . Sewing assemblies . . . Cloth processing . . . Winding operation . . . Process machinery . . . Extrusion, winding, labeling of spools, printing labels . . . Handling . . . All processing machinery to some degree . . . Warehousing and shipping . . . Dyeing and finishing . . . Steam generation . . . Materials handling . . . Doffing, feeding of cotton, inspection . . . Cutting, shearing, forming . . . Handling, conveying, transferring . . . Packaging, bundling . . . Waste incineration . . . Materials handling . . . Some sewing operations . . . Spinning and drawing yarn . . . Spinning frames . . . Roving frames . . .

Finishing (dye) equipment . . . Dyeing equipment . . . The entire operation could possibly be automated in the next few years . . . There is no automation at present except sweeping in one department . . . Packaging . . . Carding, combing . . . Stripping, boxing, conveying . . . Color mixing, finishing materials mixing . . . Conveying . . . Payroll—orders—scheduling actual production—cost control—purchasing (except raw materials)—billing . . . Dye house, and spinning room . . . Some will take place in all our facilities . . . Plan pneumatic transfer of product in inspection stage . . . Improve and widen range of present packaging machines . . . Automatic means for applying identification transfers . . . Coating and printing . . .

SIC 23—APPAREL AND ALLIED PRODUCTS

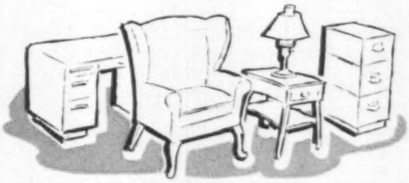
Equipment

Improve automatic shipping unit . . . Certain stitching and related operations . . . Buffing, some plating and tumbling . . . Paper bag making machinery . . . Possibly some textile machinery . . . Product planning, inventory control, complete order-bill-collect routines . . .

SIC 24—LUMBER AND WOOD PRODUCTS

Equipment

Sorting, packaging . . . Feeders for machines such as sanders, panel edgers and trimmers . . . Sawing and planing . . . Painting, assembling . . . Finishing, material transfer, stamping, testing, welding . . . Stitching (wood covers) a stapling operation . . . Laminated sheet cutoff line . . . Semiautomated flakeboard plant . . . Hope to automate plywood layup through pressing . . . Lumber ripping, cutting, sorting, sash making . . . Lumber handling . . . Assembly—ironing tables and stepladders . . . Box nailing department . . . Possibly sorting . . . Speed control . . . Loading and unloading of veneer to dryers . . .



SIC 25—FURNITURE AND FIXTURES

Equipment

Tapping operation . . . Data processing on accounts, production planning, operations, research, inventory control. Assembly machines . . . Production equipment for processing raw material . . . Feeding and straightening of coiled aluminum sheet into notching and piercing press . . . Tube bending, kinking and piercing and rolling . . . Shipping department, assembly (certain portions) . . . Side complex, finishing (paint, rub) . . . Order-invoice—inventory control . . . Cabinet assembly . . . Handling . . . Slitting and cut to length coil equipment . . . Electrostatic painting . . . Lumber handling, sorting and stacking . . . Perforating machine for sheet steel panels . . . Assembly of parts (small) . . . Welding, riveting, fastening . . . Roller assembly . . . Window shade assembly, window shade wrapping . . . Painting . . . Production machines, finishing equipment, handling equipment, warehousing . . . New products or stampings of 50M lots or more . . .

SIC 26—PAPER AND ALLIED PRODUCTS

Equipment

Most office clerical functions . . . Chemical feed systems, drying of paper, paper finishing, trimming and packaging . . . Digester cooking controls . . . Nearly all new production equipment that will be installed . . . Waste control . . . Data processing . . . Material handling, good, finished goods, chipping, pulp processing, sizing . . . Any part of the process which can apply to automation . . . Possibly combining operations . . . Printing register control . . . Paper making—stock preparation . . . More packaging and assembly . . . Several units under study . . . Packaging—same as now . . . Weighing, mixing thickness . . . Product package . . . Printing line . . . Additional mixing and blending . . . Probably portions of paper-making machine . . . Pulp manufacturing, groundwood, paper machine operations, saw mill operations, plywood operation, paper converting . . . Machine loading and unloading . . . Finished goods from manufacturing to shipping . . . Pulp preparation . . . material handling of in-process goods . . . Roll-fed, continuous run equipment . . . Stock furnish to machines . . . Packaging . . . Product manufacturing . . . Probably some controls . . . Stop-start roll machine to be continuous and automatic . . . Gradual increase in automatic controls on paper machines and pump production equipment . . . Product finishing, winder machinery . . . Wrapping, sealing, cartoning, coating control . . . Inspection—digestion . . . All possible . . . Inspection, cutting and packaging of paper . . . Electronic controls . . .

SIC 27—PRINTING AND PUBLISHING

Equipment

Typesetting . . . Paper handling . . . Ink handling . . . Paper counting and bundling . . . Paper slipping (assembly of sections) . . . Plan possible move of plant and will streamline flow to eliminate all possible handling with use of more conveyors tieing machines together in continuous flow operations . . . Accounting and order writing . . . copy preparation . . . Color registration, color correction, film development . . . Probably 50 per cent of present production facilities . . . Assembly sections (magazines) . . . Mailing room . . . Ribbon converting . . . Part of order filling . . . None planned at present other than the ones now in process . . .

SIC 28—CHEMICALS AND ALLIED PRODUCTS

Equipment

Those we can economically justify . . . Packaging . . . Plans for future in formative stage at present time . . . Warehousing . . . Process equipment . . . New processes now under development and several old batch processes . . . We have been automating and will continue to automate our production line . . . Only improvements on present systems . . . Packaging, manufacturing, services . . . Almost all processing is and will be partly or wholly automated . . . The trend in chemical plants is toward more automatic controls . . . All possible mixing and blending, filling or packaging machines . . . Liquid mixing and proportioning . . . Case packing and handling . . . All of our facilities are constantly undergoing improvement wherever possible . . . Packaging lines . . . Raw material feeds to process . . . Bag palletizing—specialty salt mixing—50 lb salt block press feed —possible 50 lb block palletizing and brine filed remote control . . . Production processing, inspection . . . Packing . . . Inventory control . . . Data processing . . . Filling and packaging . . . Warehousing . . . Most large-lot products . . . Manufacturing process . . . Assembly line equipment and material handling equipment . . . Chemical process, boilers . . . New product lines . . . Chemical processing plants . . . Bag and drum filling . . . Chemical process control . . . Case for order picking . . . Extrusion . . . Packaging . . . Shipping . . . Chemical processing . . . Continued automation of chemical processes and chemical analyses . . . Most facilities are, balance will be whenever practicable . . . Material handling-packaging . . . Forming, die trimming, form pouring and compounding . . . Process equipment . . . Most chemical processes are, at least in part, now under automatic control . . . This trend will continue . . . Manufacturing of water softener and soap . . . Warehousing . . . Any that pay out . . . Process, packaging, data handling, computer control . . . Packaging . . . Product planning and control . . . Inventory control blending and batching—pigmenting calender and takeup—inspection . . . Product drying . . . Intermediates manufacture . . . Crystal filtration . . . Small package and bulk filling departments . . . Material handling, production, warehousing, shipping, records . . . Raw material preparation . . . Propellant mixing and casting operation . . . Bottle filling and container washing . . . New plant process . . . Chemical processes are all automated to some extent . . . We are continually increasing the extent . . . Processing . . . Warehousing . . . All are now, only the degree will be increased . . . Packaging—bagging . . . Major large volume production processes, clerical functions . . . Automated in parts . . . Grinding, bulk handling . . . New equipment which is not automatic as received . . . Raw materials handling . . . Packaging, drying, weighing . . . Data processing-process control . . . Additional process equipment . . .

SIC 29—PETROLEUM AND COAL PRODUCTS

Equipment

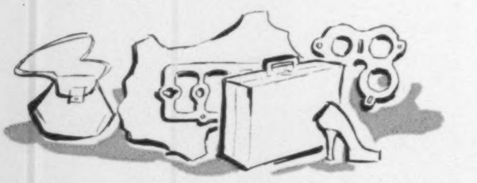
Palletizers . . . Tank gaging, blending, other processing operations . . . Gaging . . . Processing certain areas . . . Processing equipment . . . Materials handling . . . Possibly some refinery units . . . Pilot plants will be more nearly automatic in operation . . . Packaging . . . Dry felt production line . . . Blending of granules . . . Packaging or product . . . Two asphalt plants . . . All phases of our process . . . Pipeline pumping stations . . . Process stream analysis (partial) . . . Process plants . . . Chemical processes manufacturing facilities . . . Refinements in packaging and material handling . . . Material handling . . .

All future expansions and additions . . . Major process units, storage tank forms, pipelines, terminals . . . Can filling . . . Almost all of our facilities will experience further automation . .

SIC 30—RUBBER PRODUCTS

Equipment

About 60 per cent of total factory equipment . . . Mechanical handling, data processing, processing . . . Weighing . . . Handling and shipping . . . Power house . . . Molding . . . Vial capping . . . Cap storage . . . Box sealing . . . Production, warehousing, tooling . . . Finishing and assembly . . . Calendering . . . Assembly (tire building) . . . Curing . . . Warehousing . . . V-belt building machines . . . Various line assembly operations . . . Mixing of raw materials . . . As many as possible—considering expenditure . . . Vulcanizing, warehousing, miscellaneous hand operations . . . Weighing, sheeting, extrusion, molding, handling equipment . . . Flexible urethane fabricating—slitting and sawing . . . Rigid urethane production lines—small component casting . . . Stock mixing, tire finishing . . . Truck tire building and passenger tire curing . . . In varying degrees all processes . . . Office mostly . . . Manufacturing, warehousing, packaging . . . Precision automatic cutoff on extruder . . . Autoloading and unloading centerless ball grinders . . . Autopolishing hard rubber combs . . . Batch weighing . . . Tire building . . . Butadiene plant . . . Synthetic rubber plant . . . Molding of plastics, automatic screw machines, some assembly and subassembly.



SIC 31—LEATHER AND LEATHER PRODUCTS

Equipment

Sort and load dowels . . . Warehousing . . . Handling equipment, perhaps some processing equipment . . . Handling methods . . . Mostly handling and conveying . . . Possibly some process controls . . .

SIC 32—STONE, CLAY AND GLASS PRODUCTS

Equipment

Extrusion, stamping, welding . . . All pressing and weighing . . . Inspection and packing . . . Packaging . . . Bulk raw materials handling . . . Machine unloading . . . Automated control loops will be used for shale drying, raw grinding, kiln and finish grinding operations—ours is new plant scheduled for start-up in next two-three months. Warehousing and inventory control . . . All manufacturing processes . . . Process . . . Packaging . . . Machine integration . . . Kiln burning . . . Raw material input . . . Packaging and palletizing . . . Many of our pressing and finishing operations . . . Brick (tile?) packaging . . . Extrusion process . . . Glass cutting . . . Temperature control . . . Packing . . . Production . . .

Kiln operation . . . Grinding mills operation . . . Material handling portion of part of our process . . . Seven plants—70 per cent total volume in manufacture of plumbing fixtures . . . Mixing of bonds . . . Making of grinding wheels . . . Finishing of grinding wheels . . . Blending, weighing, pressing . . . Conveyors, boilers, weighing . . . Pressing (hydraulic) . . . Bagging and shipping department . . . Milling . . . Complete automation of inspection and packaging . . . Assembly, loading, unloading, plating, inspection, plastic molding . . .

Railroad car loading . . . Kiln firing equipment . . . sampling . . . All processes possible . . . Materials handling . . . Certain production equipment . . . Office procedures . . . Material handling . . . Weighing and batching . . . Packaging . . . New plant . . . Glass cutting and packaging . . . Material handling . . . Wet and dry grinding . . . Molding-packaging . . . Material handling . . . Production of rubber gaskets . . . Mixing of rubber . . . Packaging . . . Complete process equipment plus more in accounting, inventory control . . . Product handling equipment . . . Batching—product handling . . . Probably inspection and gaging . . . Kilns (firing), mixing, forming, material handling . . . Forming, mixing, material handling . . . Inspection . . . Packing of containers . . . Material handling operations . . . Mirror inspection and coatings . . . Packaging, various manufacturing functions such as counting, weighing, cutting, stacking, take-offs for finished products . . . Handling of body material between body preparation and initial pressing of product, along with handling of product between various phases of production . . . Pressing, material handling . . . Mixing and blending . . . Raw materials handling, production, inspection of product, packing of product . . . All manufacturing processes, controller's department, sales, inventory control . . .

Bulk handling and batch weighing . . . Inspection . . . Packing . . . Filling molds and pressing operations . . . Ware handling and processing to a degree . . . Redesign and improve present machinery for use at higher speeds and less labor . . . Weighing-mixing . . . Finishing grinding wheels . . . Molding grinding wheels . . . Weighing, mixing, blending, packaging . . . Cutting, trimming and boxing . . . Process and material handling equipment . . . Material handling . . .

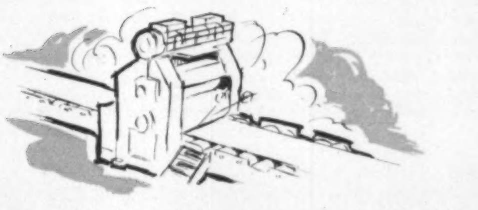
SIC 33—PRIMARY METAL INDUSTRIES

Equipment

Rolling mills, blast furnaces, processing lines . . . Ball heat treatment . . . Ball sorting . . . Ball weighing . . . Handling, production and processing equipment . . . Dust collection and handling . . . Kiln firing and control . . . Forging . . . Molding—cleaning . . . Batching equipment . . . Conveying and hoisting equipment . . . Extrusion of plastics and rubber, wire drawing, assembly, and manufacturing of coil cords . . . At least one or two molding lines . . . Heat treat fce. loading . . . Some core production machinery . . .Brinnell reading equipment . . . Additional weight, mix, blend waste disposal . . . Small bits of process . . .

Lathe . . . Pipe making machines . . . Pipe finishing machines . . . Cutting, shearing, forming . . . Inventory control, cost accounting, a few production operations . . . More production equipment . . . Rolling—cutting . . . Testing . . . Casting . . . Furnace feed . . . Sinter feed . . . Extrusion presses, packaging lines, extrusion transfer conveyors, rack conveyors . . . Molding machines . . . Core blowers . . . Payroll computations . . . Replacement—raw material handling control . . . Sorting . . . Casting finishing . . . Molding . . . Heat treating . . .

Assembly, test, some machining operations . . . Inspection and testing . . . Packaging . . . Processing machinery . . . Blast furnace operation . . . Handling . . . Inspection . . . Molding . . . Primarily press and assembly operations . . . Slab mill . . . Plate mill . . . Chemical plant . . . Heating, material flow . . . Blast furnace charging equipment, tramming and weighing (smelter) . . . Mine stope sand filling by returning concentrator tailings by pump lines to mine fill areas automatically controlled from mine to concentrator . . . Material handling . . . rolling mill . . . Conveying, cleaning, machining and assembly . . . Casting



equipment . . . Basic oxygen steelmaking . . . Blast furnace charging . . . Production planning and inventory control . . . Sand handling . . . Sand preparation . . . Moulding . . . Production equipment . . . Extrusion presses . . . Conveyors, brush burring, sawing, packaging . . . Complete assembly line and components processing . . . Nail package, coil wire bundling . . . Casting, weighing, packaging . . . and general production . . . Molding . . . Machine shop . . . Weighing and blending of process raw materials . . . Applications of computers for control of process components . . . More complete data processing . . . Production type equipment primarily . . . Mixing (material handling and crushing) . . . Some machine tools . . . Probably some foundry operations . . . Production, materials handling, assembly . . . Machining and forging . . . Casting . . . Molding-cleaning and some machining . . . Possibly reduction process adapted to computer operation—presently under study . . . Material handling in production . . . Billet shearing operations . . . In planning now . . . Inspection, packaging, weigh count . . . Ten-foot pipe production . . . Fittings production . . . Sheel sand coating . . . Bundling of product (semi-automatic) . . . Practically all or high volume production items that are produced on a continuous basis . . . Many plans . . . As much as can be done profitably . . . Complete bagging and storage of finished briquettes, possibly complete handling of wood to retorts . . . Additional rolling mills . . . Shearing of bar stock, trim presses, pickling operations, upset forging machines . . . Filtering . . . Finished product handling, warehousing, processing machinery, heat treating division, cutting and straightening operation . . . Packaging . . . Heating and handling . . .

SIC 34—FABRICATED METAL PRODUCTS

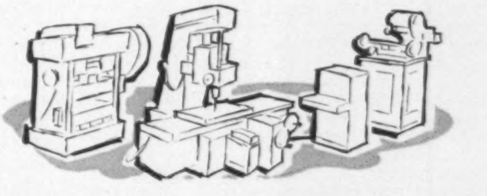
Equipment

Continuation of automating production equipment . . . We do contract stamping, forming, and welding work and any job that will show a profit by being automated will be done this way . . . Assembly and testing of finished product . . . Brazing . . . Warehousing and handling . . . Machining, polishing . . . Drawing, stamping, swaging, trimming, threading, hot stamping . . . Core making, casting . . . Forming, welding, cutting . . . Stamping assembly . . . Secondary machine work, foundry operations . . . Cover production . . . Coiling and forming . . . Some assembly and packaging, much plating . . . Assembly operation . . . Assembly . . . Turret lathes, spray and wash equipment . . . Gas stove valves . . . Finishing . . . More assembly operations and press operations . . . Shipping . . . Roll forming, painting, data processing . . . Handling, conveying assembly machines . . . Production control, inventory control, assembly furnaces, product cleaning equipment, machine card controls, testing equipment, office equipment, data processing, research laboratory test equipment and some design equipment . . . Wire forming . . . Press forming, material handling . . . Data processing—production control . . . Radial drilling . . .
Metal stamping, finishing (painting) . . . Machining, office (production control) . . . Sand mold production [illegible] sand handling systems, turret lathes . . . Production machinery, special machines, assembly, painting . . . Machining operations . . . Accounting department, partial automation of engineering department, inventory controls . . . Sand processing for foundries . . . Assembly, finishing, scrap handling . . . Numerical control for drilling machines, punching machines, and cutoff machines . . . Warehousing, data processing . . . Sand systems and machine tools . . .
Machine tools . . . Enamel spraying of V.C. ware . . . Enameling of tubs, sinks, lavatories . . . Molding of C.I. tubs, sinks, lavatories in foundry . . . Product in process handling . . . Handling of materials through sequential operations . . . Production and packaging . . . Looms . . . Coil cutting program, can manufacturing lines . . . Production equipment . . . Drilling and punching . . . Inventory control, additional inspection, additional production equipment . . . Testing, part fabrication . . . Welding . . . Some assembly operations . . . Roll forming sheet steel . . . Welding . . . Packaging . . . Machine tools . . . Material handling . . . Welding . . . Stamping, assembly . . . Assembly type production . . . Order billing—a/c payable . . . Zinc slush casting of trophy figures . . . More sub-assemblies . . . Miscellaneous fabricating operations, and possible E.D.P. . . . Machine tools . . . Stamping and draw presses . . .
Washing operation . . . Bookkeeping, stock records, payroll, accounts receivable and payable . . . Stamping, shearing, forging, heat treating . . . Punch presses . . . Secondary operations . . . Continued improvement of existing production automation and additions where feasible . . .
Cutting and punching and drilling . . . Entire plant . . . Assembly, material handling . . . Everything now done by hand will be studied for possible improvement . . . Production equipment . . . Material handling . . .

SIC 35—MACHINERY (except electrical)

Equipment

Some metal cutting . . . Melting, molding, and galvanizing . . . Inventory control, production controls . . . Accounting, production control, inventory . . . Tire mold manufacture . . . Some machining operations . . . Size inspection of certain parts . . . Complete testing machine to give pressure, vacuum, capacity, and hp of pumps automatically . . . Welding and cutting equipment . . . Die casting and assembly . . . Production control . . . Machining and molding . . . Primary heavy machinery and machine tools . . . Data processing . . . Production equipment . . . Fabrication and assembly welding . . . Certain machine tools . . . Data processing and machining operations . . . Most assembly and stamping . . . Processing, inspection and testing . . . Stock control (inventory) . . . Welding, punching plates, load-out systems . . . Machine tools and welders . . . Primarily assembly and some machining operations . . . Machining . . . Inventory controls and various machine tools depending on the economics involved . . . Punch presses and machine tools . . . Die casting and plastic molding . . . Possibly transfer systems . . . Certain production equipment . . .
Cost accounting . . . Production control . . . Material handling . . . Accounting phases . . . Milling and drilling . . . Tank welding and painting . . . Emphasis on numerical control machine tools and process equipment—welding, winding . . . Handling systems . . . Heat treating (induction), steel burning, and additional welding . . . Die casting . . . Inventory control . . . Positioning for drill press operations . . . Turret lathe control . . . Paint, stamping, tube work . . . Assembly . . . Machine tools . . . Production scheduling . . . Welding . . . Casting, production testing of the product, and assembly . . . More machine tools . . .
Making of drills and end mills . . . Machine tools . . . Material handling, data processing, production control . . . Production equipment . . . Most data processing, probably some numerical control . . . Some machine tools . . . Painting, plastic rolling, stamping, forming, and small parts assembly . . . Machining, design automation, assembly, manufacture of plastics, molds . . . Portions of pipe manufacturing process . . . Portions of housewares manufacturing process . . . Possibly heat treating . . . Drills . . . Boring mill . . . Some drilling and welding . . . Milling machines, drilling machines, turret lathe . . .



Drilling operations and grinding operations . . . Steel conditioning . . . Extruding presses . . . Few machine tools and inspection items . . . Partial armature assembly . . . Stamping . . . Cladding . . . and assembly . . . Production control . . . Manufacturing process machine tools . . . Assembly, needle loading, and grinding . . . Materials handling, inventory control, and packaging . . . Improve use and expand present equipment . . . Machine tools, minor assembly welding . . . Production equipment . . . Presswork and assembly . . . Production machine tools final assembly operations, some office equipment, handling, washing and storage conveyorized . . .

AUTOMATION TRENDS

Inspection and testing (Special Prod. Div.) . . . Small components . . . Punching of belt and painting of small parts . . . . Possibly production line . . . Threading, assembly, brazing . . . Material handling, welding and cost control . . . Production equipment and bag-making machinery . . . Additional machining and welding facilities . . . Machine shop . . . Machining, assembly, and office . . . Assembly operations and some inspection operations . . . Machine tools . . . Welding and assembly . . . Milling and drilling small castings . . . Special welding, machining and fabrication operations . . .

Boring . . . Machine tool . . . Production equipment . . . Horizontal and vertical boring machines . . . Production equipment, mainly machine tools . . . Assembly . . . Counting and packaging machines . . .

Components

Spin welding machines for plastic field . . . Conveyors . . . Automotive seat spring equipment . . . Transfers for molding dies . . . Various material feeding devices for production machinery . . . Tape controlled gaging . . . An automatic door for pressure vessels . . . A continuous extraction system for rendering animal products . . . Being mainly engaged in specialized components, company designs to conform to needs of automation requirements—aircraft and missile components are primary field . . . Explosion proof proximity switch . . . Automatic testing equipment for aerosol products manufacturing . . . Fixture transportation or transfer feeding and orienting for automatic machining and assembly . . . Oil and grease handling, mixing, packaging . . . Centralized control of entire plants . . . Automated stacking devices . . . Various pinch valves systems . . . Any wheel dressing and sizing on all types of grinders . . . Automatic leather area marker . . . Punched card adapter to area computer . . . Constant pressure lube systems for slide-way lubrication . . . New line of automated feed production equipment for the agriculture industry . . . IBM and Remington-Rand card sensing and programming equipment . . .

Automatic machinery for the electronic industry . . . Automatic devices for mechanized order selection . . . Automatic edger setworks, edging pickers, edger shadow line . . . Sawmill carriage operating equipment . . . industrial drives, and others for manufacture of lumber and associated products . . . Standard flexible and versatile assembly system components . . . Parts manipulators, feeding and orientation devices, multioperation programmable parts handling and system control mechanisms . . . Our principal products are either inherently usable in automation or adaptable with addition of the control apparatus . . . Automatic order assembly systems . . . Carton handling . . . Container handling . . . Stacking machines for plastic and rubber industries . . . Automatic gaging system . . . Colorimetric systems . . . Centerless grinders . . . Cylindrical grinders . . . Pump seating apparatus, impeller grinding machine . . . Large integrated refrigeration systems . . . Commercial package of control elements which can be used with various single-revolution clutches and intermittent drives for simplified installation by the user . . . Saw controls . . . Printing and marking devices . . . Semiautomatic conveying systems . . . Single and up to seven hydraulic cylinders, the pistons of which can be stopped at any remotely controlled and adjusted point by pushbutton, selector switch, or dial setting . . . Foundry mold rollovers . . . Foundry castings knockout devices . . . Foundry molding operations . . . Computers . . . Automatic punching device from desk type computer . . . Process of pulverizing completely frozen food blocks . . . Transfer devices with cylinders (air or hydraulic) . . . Transfer devices by gravity (uniform packages) . . . Transfer devices by air blast . . . Infinite resolution wire wound potentiometers . . . Stackers (milk case) . . . Casers (paper and glass bottles) . . . Unstackers . . . Mail sack sorter for railroad terminals and post office . . . Letter sorter . . . Parcel sorter . . . Systems for automatic warehouse . . . Automatic spring processing machines . . . Special automatic welding machines . . . Standard automatic welding machines . . . Automatic tape controlled punch press . . .

Data gathering equipment for automatic reporting of inventory, labor distribution and quality control . . . Digital—analog servos . . . Pulse code telemetering analog to digital converters . . . Automatic handling and processing systems for bars, tubing, plates . . . New concepts in basic chassis for application to automatic assembly equipment requirements, including turret and in-line configurations . . . Considerable variation in range of size and considerable use of multiple turret and tool plate arrangements . . . Index units . . . Transfer tables . . . Secondary operating machinery . . . New custom special machine is our main endeavor . . . Dial type, trunnion, transfer . . . The automatic control systems designs are being constantly changed to suit over-all control systems and integration in the various wood processing plant systems . . . Weighing and batching controls . . . Automatic measuring, counting and timing devices . . . Special hydraulic equipment . . . Specifically we are now marketing a hydraulic workhead for drilling, tapping and general machine operations on small parts . . . Our own processing machinery . . . Automatic pallet loaders, automatic pallet unloaders, automatic conveyor systems . . . Slip clutches, universal joints, power drive assemblies . . . New tube cutoff machine . . . End finishing machine for tubing . . . Automatic loading equipment for above . . . Boxing machines for poultry processing . . . Cable link conveyors with limber dip to unload poultry, sections of conveyor over scalding tanks to raise poultry from scalder when conveyor stops (own inventions) . . . Continuous improvements in the operation of automatic elevator controls, single and group operation, demand supervisory system . . .

SIC 36—ELECTRICAL MACHINERY

Equipment

Assembly and processing equipment . . . Production and inventory controls, accounting, testing and some inspection . . . Assembly operations and silver soldering . . . Production facilities . . . Assembly operations . . . Manufacturing, production planning, and inventory control . . . Machining and assembly . . . Paint and varnish oven, rotor turning and winding . . . Handling and conveying industrial assemblies . . . Presswork, assembly, and order picking . . . Punch press operations . . . Manufacture of tantalum capacitors . . . Deburring, welding contacts, and assembly . . . Press room assembly operations . . .

Machining of cast iron gear housings, heat treating gears, and increased degree of automation of the two . . . Shearing and roll forming . . . Principally assembly machines . . . Production operations . . . Coil to sheet steel shearing, forming . . . Conveyorized cleaning . . . Bonderizing and finishing system . . . Machine tools and material handling . . . Production equipment . . . Subfractional horsepower motors assembly, miscellaneous subcontract machining using build-up tear down modules . . . Envelope assemblies . . . Order pulling, inventory control, and production equipment . . . Production and testing equipment and inspection devices . . . Stamping dies . . . Production and inventory control . . . Tape controlled machine tool . . . Processing (cutting and forming component leads) of electrical parts . . . also printed circuit board assembly, as well as wire cutting, stripping, marking . . . Tank manufacturing . . . Inspection and winding . . . Stamping and drawing operations, machining operations, handling and storage . . . Transmission machining lines, paint system (including washer, flow-coat and finish coat) . . . Light bulb assembly and testing equipment to a higher degree than at present . . . Probably 60-75 per cent of metalworking equipment (lathes, milling) . . . Production planning and control . . . Assembly machines, molding, extruding, stamping and drawing . . . Assembly . . . Tank fabrication . . . Deflashing of moldings, terminal wire manufacturing and assembly . . . Production . . . Switch subassemblies . . . Assembly equipment . . . Electronic circuit and component testing . . . Our subassembly and assembly operations . . . Production equipment . . . Some press operations (punch), additional production control and scheduling, some subassembly and welding operations . . .

Automatic moulding . . . Punch press, production and inventory control (further refinements) . . . Assembly, testing and packaging . . . Fabrication . . . Assembly and dc part fabrication . . . Material handling and painting . . . Machine tools and assembly machines . . . Motor shop . . . Machine tools and material handling . . . Printed, wiring and component insertion . . . Assembly . . . Production and inventory control . . . Sales analysis . . . Production control, cost accounting, probably payroll, some production machining, through the purchase of more automatic machine tools . . . Machine shop . . .

Coil winding, stator stacking, stator encapsulation . . . 50 per cent of machining, 90 per cent of testing . . . All data in regard to inventory and production . . . Processing equipment . . . Lamination assembly (field-rotor) . . . Testing, inspection, production assembly . . . Assembly and testing . . . Manufacture of basic elements of transformers core and coil . . . Assembly and testing operations . . . Mica coating, socket assembly and connector assembly . . . All high volume manufacturing facilities . . . Nearly all processing . . . Electronic assemblies . . . Processing equipment, production and inventory control, and tape controlled machine tools . . .

Machines (production) data logging . . . Some assembly operations . . . Winding, shaft making . . . Forming, finishing, plating, sorting, handling . . . Impregnation, final testing, winding, welding . . . Assembly machines, filling and closing, warehousing . . . Payroll, accounting and engineering calculation, possibly inventory and production control . . . Plate—separator stacking . . . Bakelite branding, electrical component welding . . . Lead casting . . . Assembling, painting operations . . . Production, assembly equipment . . . Parts assembly, packaging, and coating . . . Machine tools and electrical assembly . . . More production control functions . . . Primarily forging, casting, and assembly operations . . . Also computer for data processing and PC inventory control . . . Laminating press, annealing ovens . . . Stator building, stator insulation, and leaf spring manufacture . . . More machine tools and processes . . . Paperwork control procedures, machining of some components, inspection of some components . . . Data processing facilities . . . Purchasing, manufacturing, design, warehousing, inventory, administration, accounting . . . Assembly operations . . . Manufacturing storerooms, several apparatus assembly lines . . . Further assembly, fabrication, and testing . . .

Various assembly operations . . . Materials handling, inventory data processing, and engineering computations . . . Production equipment where economically feasible . . . Armature winding, punch press, and shaft machining . . . Component assembly operations . . . Coil winding to some degree, varnish baking process, storage, feeding, and sorting . . . Assembly of small electronic circuits . . . Machine tools—considering numerical tape control for hole positioning and milling . . .

Components

We are manufacturers of component parts such as Mica capacitors, tantalum capacitors, electrolytic capacitors and paper-film capacitors . . . Tape applicator, ink stamping, glue applicator . . . Special rotating cam limit switches . . . Solid state timers, time delays, memories for line movement rectifiers and transistors, solid state counters, . . . Rotating cam limit switches, rotary limit switches, terminal blocks, explosion proof equipment, electronic enclosures—amplifiers . . .

Information processing switching devices and systems . . . Servo control components . . .

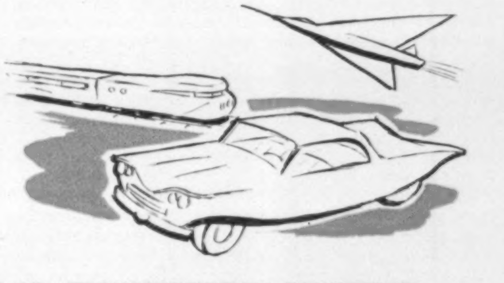
Automatic and semiautomatic card operated lighting control systems for control of intensity, color, and other qualities of lighting systems in theaters, studios . . . Electrohydraulic transducers and drives . . . Servo positioning controls, temperature controls—modulated completely solid state . . . Voltage and current monitors, programmers . . . TV studio programming system (automatically programs all TV activities electronically) . . . Computer type research oriented at present . . . Motor controls . . . Fault locating instrument to facilitate troubleshooting of complex electrical control circuits . . .

Automatic multiple material weigh batching . . . Integrated electronics circuit packages for computers or control systems . . . Inspection comparitor-master to slave, both TV and mechanical . . . Combined recorders and programmers . . . Force, displacement, pressure and temperature control systems (electronic) . . . Not many at this location other than standard control components i.e., they are developed first for control applications and used secondarily for automation . . . Static component relays . . . Transistorized remote controls . . . Static voltage eliminators . . .

Special computer systems built specifically to customer's needs . . . Silicon controlled rectifier circuits for static switching applications . . . Automatic assembly and transfer mechanisms . . . Quick change preset tools, computerized programming, reusable fixtures, optical tooling . . . Servo and computer power supplies . . . Automatic control of natural gas line via analog-digital computer—starts/stops compressor and selects required pockets fully automatic . . .

Automatic dispatch system for conveyors and other mechanical handling devices . . . Switches . . . High angle X-ray diffraction analyzer . . . Advanced process and pipeline control systems and components . . . Digital volt, ohm wattmeters, high precision ac-dc transfer device . . . Solid state amplifiers, relays, using transistors, magnetic amplifiers, and saturable reactors . . . Tape controlled oxygen cutting machine, tape controlled sand slinger (foundry equipment) . . . Contour control . . . Transistorized demodulator for use with differential transformers . . . Impulse counter with clutch reset . . . Transistorized timer . . . Motion and force transmitters (differential transformer) . . .

Tubes . . . Circuitry and assemblies for control of a steel mill . . . Winding machines . . . Testing devices for motors . . . Transducers, general electronic control, bin level control —speed sensing devices . . . Special purpose motor controls . . . Continually developing the additional components and accessories to supplement the control systems for automation . . . Machine tool and process central memories . . . Computer, dimensional, electrical, electronic, instrument, mechanical, numerical, process, and program controls . . . Testing, inspection, visual, and audible devices . . . Automatic length measuring . . . Hot (steel) weighing systems . . . Temperature-controlled cutoff gages . . . Electrical and electronic controls . . . Precise power source . . . Automating winding, lacing, stripping and tinning on electrical wire harnesses . . . Swaging, straightening, sizing and cutting to length stranded wire for push-pull controls . . . Machine tool controller . . . Timing and counting devices . . .



SIC 37—TRANSPORTATION EQUIPMENT

Equipment

Two or three production and process lines . . . Riveting and forming operations . . . 3D milling machines and lathes . . . tape control . . . Manufacturing and paper functions . . . Machining of the steering gear housing and shock absorber assemblies . . . Sales order—production planning—shop production—inventory control . . . Manual S576 gear housing line torque converter operations and knuckle arm machining . . . Machine shop mills, welding equipment . . . Production control, some purchasing, inventories, budgets, some machine tools . . .

Lathes and other machine tools . . . More machine tools . . . Gaging and more assembly operations . . . Assembly operations and material handling . . . Casting, finishing, and assembly . . . Packaging, assembly, molding, and compression . . . Some conveyor and loading and unloading stations . . . Presses and possible shear line for coil stock . . . Continuous mixing and casting of rocket motors . . . Polishing . . . Work orders, order location, time reporting, scheduling, and shop loading . . . Horizontal boring, milling, and drilling machinery . . .

Press floor equipment . . . Stamping, polishing, plating, production control . . . Printed circuit assembly . . . Weighing and handling . . . Assembly . . . Almost all machine tools . . . Mainly machine tools . . . Brazing, polishing, and pickling . . . Bumper facilities . . . Piston pin manufacturing, water and oil pump machining and assembly . . . Manufacturing . . . Data processing and portions of the machine shop . . . Assembly operations, die casting, presswork, and spot welding . . . Working on milling and drilling operations . . . Cleaning and painting . . .

Components

Have 200 R&D projects on file . . . Control computers . . . Machine tools for process operations . . .

SIC-38—INSTRUMENTS

Equipment

Plastic processing machine . . . Production planning, sales orders . . . Automatic hardening and annealing, semiautomatic needle handling . . . Painting and metal finishing operations, testing and calibration, various material handling, some drill press operations . . . Assembly . . . Processing and production equipment . . . Processing . . . Soldering, cleaning, and grinding . . .

Some consumer items, parts manufacturing and assembly . . . Additional machine tools . . . Plating, glass processing, painting, die casting, plastic molding . . . Assembly tooling . . . Paper coating . . . Assembly operations . . . Filling and sealing glass tubes, painting, assembly operations . . . Handling and all production . . . Cost processing and production . . . Entire plant . . . Painting and finishing department . . . Accounting, order handling, production planning and control . . . Stages of manufacturing . . .

Components

Automatic blenders . . . Voice recognition and coding . . . Automatic processing for crystal/transistor manufacture . . . Miniature precision components such as timers, programmers, transducers, micromodules, relays, and binary counters . . . Data processing devices . . . Instruments for on-line chemical analysis . . . Computer-controllers . . . Systems for automatic inventory control . . . Gas analyzers . . . Nuclear blast furnace burden level control . . . Numerical control . . . Oil production instruments . . . Stapling machine only . . . Air-operated valves . . . Cycle/sequence controls . . . Data logging . . . Data transmission . . . Scanning systems . . .

Electronic controls for measuring temperature, pressure, liquid level, fluid flow . . . Precision timing and programming device temperature control . . . Line of transducers, pressure transducers . . . Gas chromotography analyses and accessories, gravitometers, viscometers . . . Batch counter controls . . . Machine controls . . . Memory systems . . . Electronic feedwater level control . . . Sensitive electronic controls . . . Voltage and current comparators . . .

SIC 39—MISCELLANEOUS MANUFACTURING

Equipment

Painting and finishing of metal parts, cleaning and transfer of plastic parts, and portions of electrical assembly . . . Automatic neck forming on cylinders, automatic hydrostatic testing CO_2 charging cylinders, batching, assembly, and leak testing . . . Weighing, materials handling . . . Assembly, fabricating, machining . . . Assembly, machining operations, mechanics of drilling . . . Card cutting and packing . . . Production equipment, production control, and handling equipment . . . Filling and stamping . . . Plating . . . Assembly . . . Assembly, packaging, data processing . . .

Zipper final assembly . . . Bearing measuring . . . Processing, packaging . . . Tip drilling, slitting, reaming, sinking, tip assembly, and barrel assembly . . . Metal fabrication . . . Strip cartridge line . . . Packaging . . . Filling, machining . . . Finishing, welding, grinding, forming, Material handling . . . Varnishing, packaging, rubber production plant, toy assembly . . . Assembly . . .

Components

Dispensing equipment and accessory pumping equipment for liquid brine and hot liquids used in food processing plants . . . Packing plants, TV dinners, spray dispensers, tablet dispensers, and bulk salters . . .

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SIC 8911—ENGINEERING AND ARCHITECTURE

Equipment

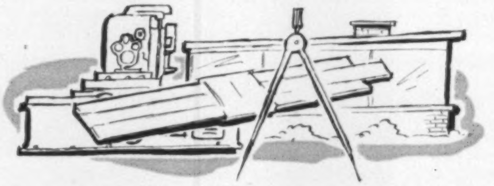
Subassembly . . . Joint installation in pavements . . . Handling . . . Engineering and sales . . . Steam electric generating plants . . . Material handling . . . Every project we do . . . Information retrieval, bulk chemical handling, volume specification mixing . . . Machining . . . All production equipment . . . Production, data processing . . . Calibrating and testing . . .

Components

Air traffic control . . . Machinery and devices relating to (1) printing or webs (continuous) for paper, plastics, metals . . . (2) fabrication and assembling parts in manufacturing operations . . . and (3) materials handling and processing operations . . . Liquid measuring system . . . New line of all transistorized plug-in circuit modules used for logic in industrial control systems, modified for our own systems only . . . Card readers . . . Readouts . . . Combined vibrating and insertion hydraulic fixtures with automatic stops, sensing fingers, and withdrawal movements . . .

Plastic extruder overload shutoff . . . Adjustable clearance plug valve . . . Automatic book separating devices . . . Automatic materials positioning device . . . Roll packaging machine . . . Special welding equipment . . . Materials handling equipment . . . Automatic performance computer . . . New drives and handling equipment . . . Quick changeover air-oil drilling heads . . . Filling and calibration equipment for filling temperature control elements . . . Portable size measurement appartus . . . Production test equipment . . . Automatic semiconductor checkers . . . New devices, machines, transducers for the graphic arts industries . . .

High viscosity nozzles, polymer flash heaters, plastic extrusion techniques . . . Machines for manufacture of miniature capacitors . . . Automated land surveying machine . . . Faster acting air valves . . . Standardization of cylinders . . . Quick fill system for filling air line lubricator bowls . . . Electric sequence and process control timers . . . Material handling devices . . . Automatic feeds and positioners . . . Indexing devices . . .

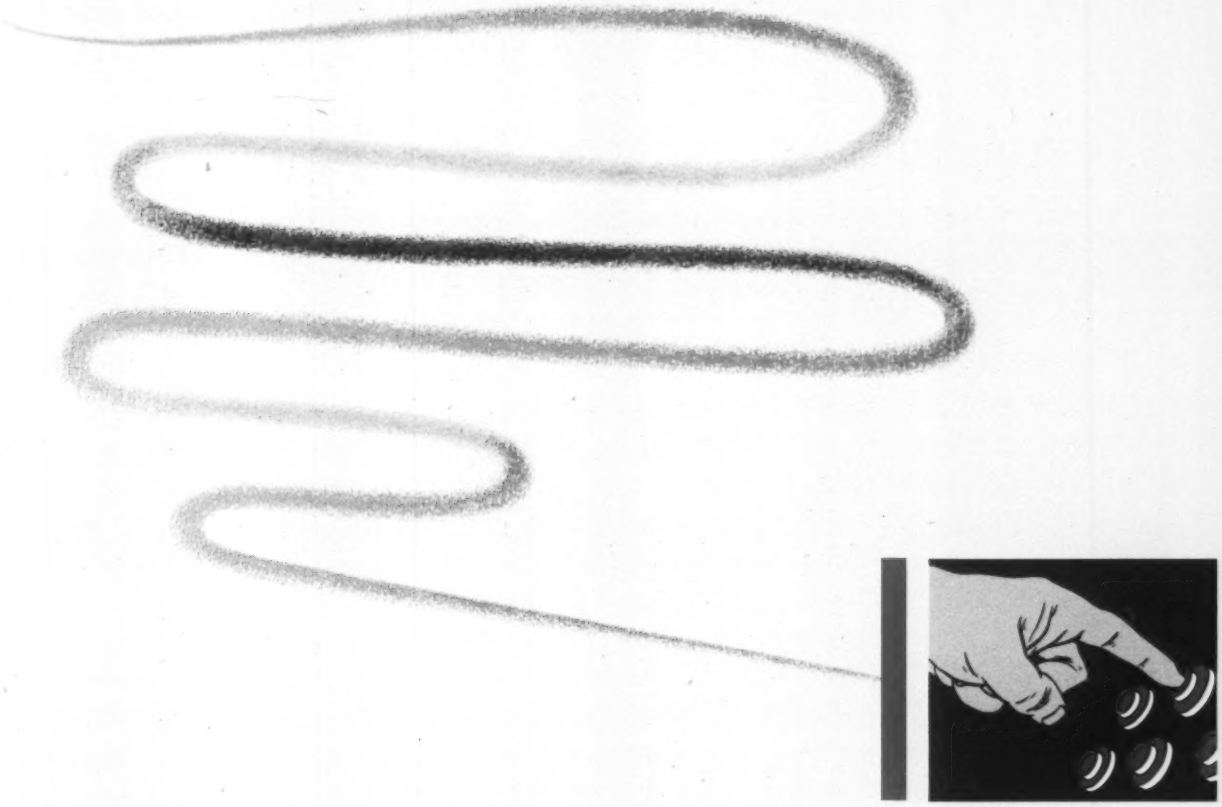


Solids, soluble and insoluble, density control . . . Continuously modulating light dimming or light level control for rapid start tubular lamps . . . New low voltage liquid level controls . . . new solid state interval timer, 0 to 7 minutes . . . Design, modifications and revamp of feeding, controls, and useage of data processing, process handling, and TV systems . . . Medical electronics . . . Manual control devices—lever switches, P.B's . . . Sheet feeding machinery . . . Hot steel computing cutoff to large machinery . . . Recoilers . . . Steel automatic stretcher . . . Tape controlled truss manufacturing drills . . . Tape controlled benders . . . Silicon controlled rectifier triggers and magnetic particle clutches, and brakes . . . Copy machines . . . Static controls . . . Punch card parking ticketing . . . Operations for minimizing labor costs and errors . . . Servo-valve packaging machine . . . Communications and electrical . . . One item is a continuous analog readout measuring instrument used in manufacturing equipment such as lathes, mills . . .

Data retrieval systems . . . Tape controls for machine tools . . . Encoding and decoding equipment for putting information and control data onto telephone lines . . . Plywood handling . . . Feeders, index and transfer devices . . . Electric supervisory systems . . . Multiple gang locked and interlocked switching packages, special control panels . . . Automatic lumber tally system . . . Automatic programs . . . Automatic inspection of electronic components . . . Automatic inspection by electronics of processing . . . Controls using magnetic tape . . . Automatic length and width sorter . . . Automatic packager . . .

Circle 669 on Page 19→

MOTION ... *by proxy*



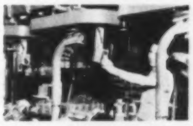
Motion . . . movement . . . mobility . . . call it what you will, it's the heart of industry.

Man can move parts or products by one of two basic methods: back power or finger power. Finger power means pushing a button or setting a dial, and watching the product move AUTOMATICALLY to any one of a number of predetermined points. This is called AUTOMATIC DISPATCHING.

It takes experience, research, and technical knowledge to turn out a workable AUTOMATIC DISPATCHING system; it takes Systems Engineers with electrical and mechanical experience combined with complete manufacturing and installation facilities at their disposal.

With these diversified skills and facilities, the Jervis B. Webb Company will assume complete responsibility for putting your product in motion.

Send for free 8-page brochure on automatic dispatching



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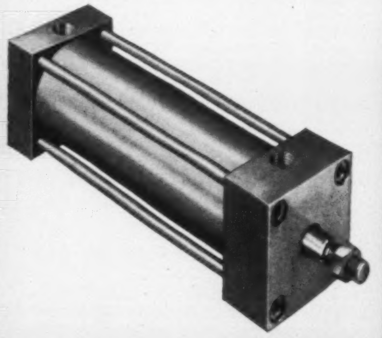
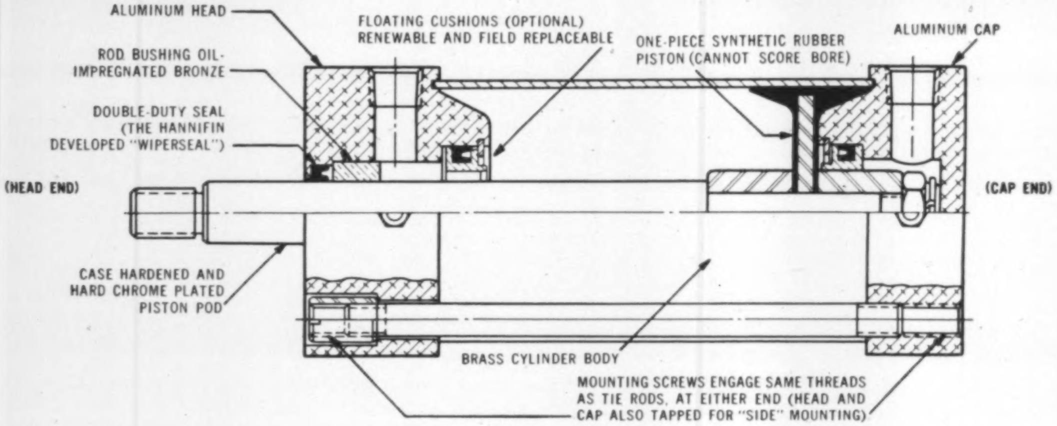
NEW FROM HANNIFIN
A GENERAL PURPOSE AIR CYLINDER
that gives you quality, low cost and mounting versatility



Hannifin announces a new design concept that gives you quality and economy in one package, the new Series "C" air power cylinder with . . .

- One compact basic design that provides side, cap end, or head end mounting without modification.
- Flange, foot or pivot mountings easily made with standard attachments.
- Rust proof construction — brass cylinder body, head and cap of aluminum.
- Cushions that do not change cylinder length—furnished as option or added in field with simple kit.
- An ingenious one-piece piston that cannot score the bore — of synthetic rubber, molded around a rugged steel disc.
- Piston rod both case hardened and hard chrome plated, polished to a fine finish for low friction and long seal life. Corrosion resistant.
- Rod bearing an oil-impregnated bronze bushing. Minimizes friction.
- Gland seal the Hannifin-developed "Wiperseal"—both a rod wiper and an efficient dynamic seal. It keeps air in, dirt out.
- 5 bore sizes—1¼", 1¾", 2½", 3⅝" and 4½". Stock strokes from 1" to 20" in 1" increments.

This new Hannifin cylinder design is the latest of the complete Hannifin line of air power cylinders. To help you choose the best Hannifin cylinder for your application, talk to your nearby Parker-Hannifin man. He knows cylinders!


ALUMINUM HEAD
FLOATING CUSHIONS (OPTIONAL) RENEWABLE AND FIELD REPLACEABLE
ONE-PIECE SYNTHETIC RUBBER PISTON (CANNOT SCORE BORE)
ALUMINUM CAP
ROD BUSHING OIL-IMPREGNATED BRONZE
DOUBLE-DUTY SEAL (THE HANNIFIN DEVELOPED "WIPERSEAL")
(HEAD END)
(CAP END)
CASE HARDENED AND HARD CHROME PLATED PISTON POD
BRASS CYLINDER BODY
MOUNTING SCREWS ENGAGE SAME THREADS AS TIE RODS, AT EITHER END (HEAD AND CAP ALSO TAPPED FOR "SIDE" MOUNTING)

PARKER HANNIFIN CORPORATION

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PNEUMATIC AND HYDRAULIC SYSTEM COMPONENTS

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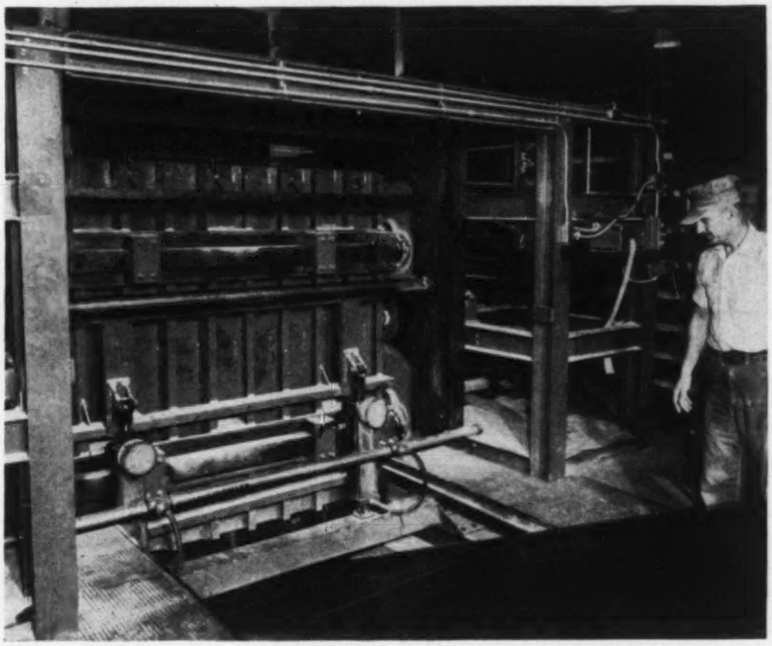
EUROPEAN DIVISION • PARKER-HANNIFIN N.V. • SCHIPHOL • THE NETHERLANDS

Circle 670 on Page 19

detroit dateline

By **LEE D. MILLER**, Associate Editor



Special vertical platen press is part of integrated line to mix and calender a rubber strip then cut out blanks for rubber mats. A continuous strip of rubber moves down into the press from upper left. Unique drive and control system moves the platens through circular paths to cut the blanks from the strip and drop them on the conveyor in foreground. Back of one platen, square sections of its two support shafts, and two support cylinders are visible in this view. Operators pick blanks off conveyor while scrap is conveyed back to calender.

Manufacturing Stretch

WHAT happens in the stretch may be the deciding factor in many kinds of activities. When the habitue of the equine oval hears that ". . . it's Girdle in the stretch . . ." he knows whether or not his nag is then closest to the wire, but a trip to the payoff window isn't in order until after the homestretch has been traversed.

30-40-60

In the world of manufacturing competition, the payoff standing isn't really known until the product has traversed the stretch to a user's "home" and all the items of income and expense have made their influences felt. As a general rule it seems logical to expect that increases in productivity will favorably influence the payoff standing. That's one of the basic reasons for the application of manufacturing engineering skills.

Even though the manufacturing engineer dreams up a production system that will let the production operator make more pieces every hour, the team isn't assured of placing well in the manufacturing race. Among the many factors involved is the question of how many hours per week the operator will perform at his new level of productivity per manhour and for what weekly cost.

Some potential quarterbacks have suggested signals by which the operator might, for instance, work fewer hours per week for the same weekly cost. Under these conditions the team might thereby produce no more, or even fewer, units of output per week although operator productivity per hour had increased. On performance of this character, the team standing in a competitive world would not be likely to improve and would probably grow worse.

A National League

Field of play for the teams that might find such signals in the game can be considered as national in scope. Secretary of Labor Goldberg has created the Advisory Committee on Automation and Manpower to advise the Department of Labor ". . . in its efforts to develop programs for improvements in testing, counseling, training, and placement of workers who have been displaced by automation or who lack skills needed by technological developments. . . ."

Deputy Assistant Secretary Seymour L. Wolfbein, who is director of the newly formed Office of Automation and Manpower, is the chairman of the Advisory Committee on Automation and Manpower. This committee, of which Roger W. Bolz, Publisher and Editorial Director of AUTOMATION is a member, has already heard suggestions that the approach should be to shorten the workweek in a manner similar to the 30-40-60 signals.

Since the activities of this committee are of importance to past, present, and potential automaters, pertinent comments and reports of experiences from industry to the committee would be appropriate. Such information can be directed to Mr. Bolz, other committee members, or Mr. Wolfbein.

A committee to consider even broader aspects of our industrial scene has been formed as the Presidential Advisory Committee on Labor-Management. Pres. Kennedy is reported to have told this group: "The purpose of this committee is to give direction to the general movement of wages and prices so that the general welfare of this country can be served."

First major discussions of this group were concerned with how to reduce unemployment and to get maximum benefits from automation and other technological advances.

This group, too, heard a proposal for consideration of a shorter workweek.

Stretching a reduced volume of goods over a fixed population, or a fixed volume of goods over an increased population, or an increased volume of goods over a population which has increased at a greater rate will not increase the standard of living. Nor is increased productivity per manhour alone sufficient to attain this goal; increased total output per man must be obtained.

Automation in Their Orbit

In the USSR the need for greater total production before greater leisure seems to be acknowledged. In opening remarks to the First International Congress of the IFAC (International Federation on Automatic Control), V. A. Trapeznikov, President of the Institute of Automation and Telemechanics put them in that order.

We may be competing with Red salesmen for automotive and other markets on an important scale some day. It will be unfortunate, to say the least, if we enter such a contest with artificial hobbles applied to our use of automation.

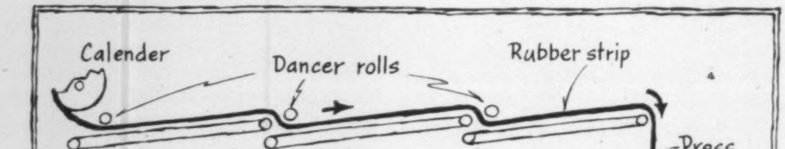
Not Flat on Mat

So far we haven't been knocked flat on the mat. In fact, the accompanying illustrations indicate a system for production of automotive rubber mats that augers well for competitive standing on those items. Anchor Industries Inc. uses the installation in the manufacture of rubber mats, from 0.055 to 0.250 inch thick, up to about 64 inches in width, and as much as 9 feet in length.

Anchor's present system is based on principles developed over many years and uses a new cutting press built to their specifications by May-Fran Mfg. Co. The system features continuous feed of a rubber strip to the cutting press, which has vertical spring-loaded platens. The strip is fed down between the platens of the press until the desired length is hanging in place, then the press is automatically cycled. After the platens open, mat blanks and scrap fall onto a conveyor.

Stretch is an important consideration in the processing of these items, especially in the lighter gages. If the strip is stretched or distorted in other ways when the blank is cut, the product will not be the right size or shape. Hanging the strip down between the platens eliminates variable distortions and makes for product uniformity.

Stretch in reverse is the problem in conveying the rubber strip from the calender to the press. During the calendering operations, rubber temperatures rise. As it is conveyed to the press it cools and contracts. If rate of delivery to the press were the same as the 60 fpm at which the strip leaves the calender, the over-all contraction would cause tearing of the strip.



Rubber strip is conveyed from calender to cutting press by three conveyors individually controlled by dancer rolls to prevent tearing of the strip as it cools and contracts. Each platen is supported by two horizontal support shafts and two pneumatic cylinders. Ends of the support shafts are eccentrically mounted in bushings in large bull gears. As the gears simultaneously rotate, the platens close and open with circular motions.

This problem is attacked by using three short conveyors instead of one long conveyor to move the strip to the cutting press. A dancer roll at the entry end of each conveyor contacts a loop in the strip and controls the drive to that conveyor so that the strip is not pulled apart.

The press cycle is automatically started when a limit switch is tripped by a cam driven from the final feed conveyor. This switch is thereby tripped every time the conveyor advances a preset length. When a change in feed length is desired, it is readily made by adjusting a variable pitch pulley to change the drive ratio between conveyor and cam.

Going in Circles

An interesting feature of the press construction is the arrangement to support and drive the platens. Both platens move in circular paths when viewed from the side of the press. Each platen is supported by two pneumatic cylinders and two support shafts.

The ends of each support shaft are carried by eccentric bearings in 36-inch bull gears. (Those eight gears add up to a lot of bull gear, too.) Co-ordinated rotation of the bull gears about their own centers moves the support shafts in circles. The platens thus move in circles too since they ride on the shafts.

Springs between the support shafts and the backs of the platens transmit the 20,000-lb force used to push the die rules through the rubber strip. Bob Beidle, plant engineer at Anchor, explains that this spring-loaded design is used to obtain the proper speed of cutting.

Whether the manufacturing stretch to be considered is the race to the payoff window or a characteristic of the product, appropriate automation seems to be in winning ticket. Performers of the manufacturing engineering function, regardless of the title on their calling card, are well-advised to keep the tools of automation sharp to handle the problems of manufacturing stretches.

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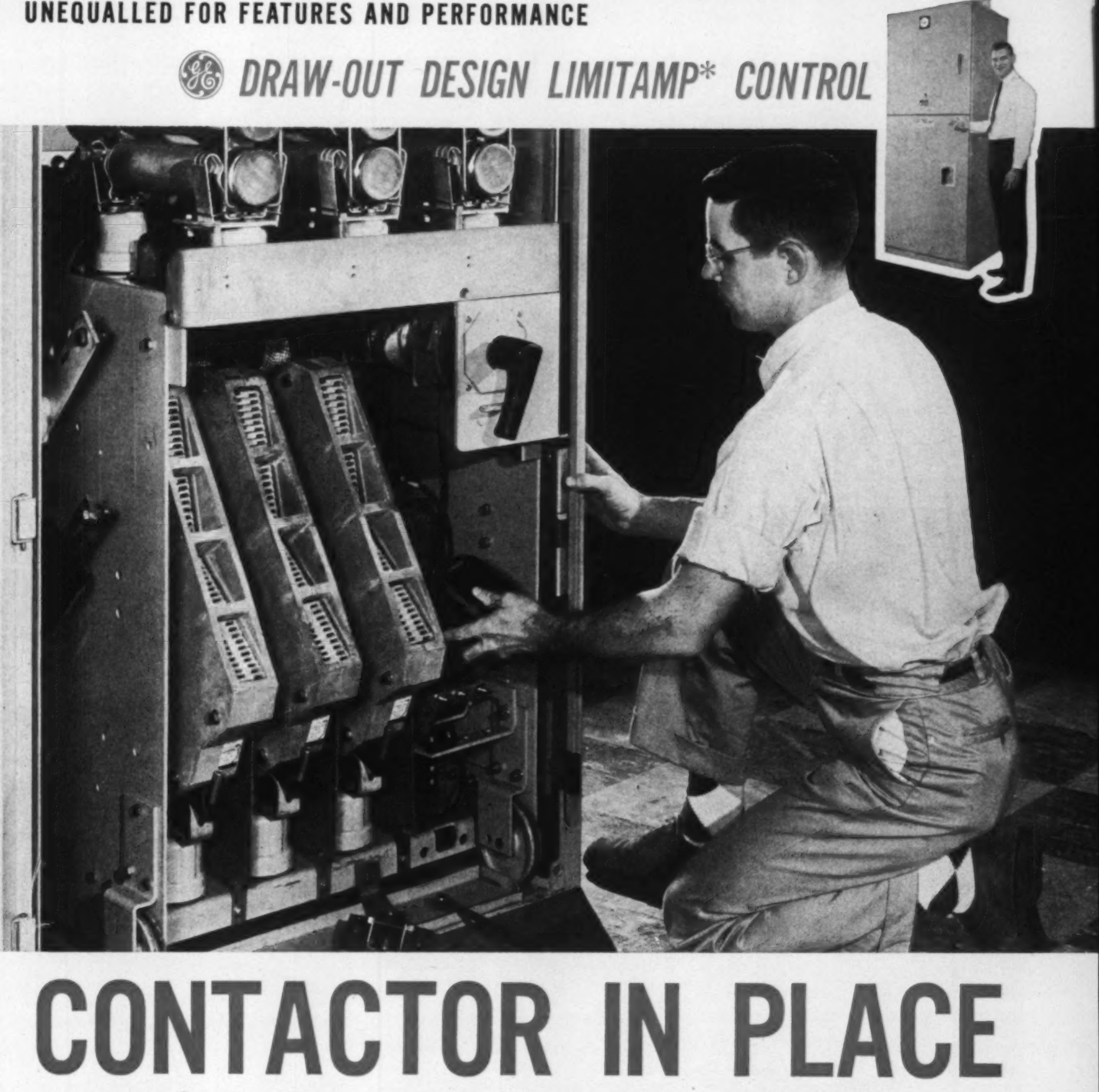

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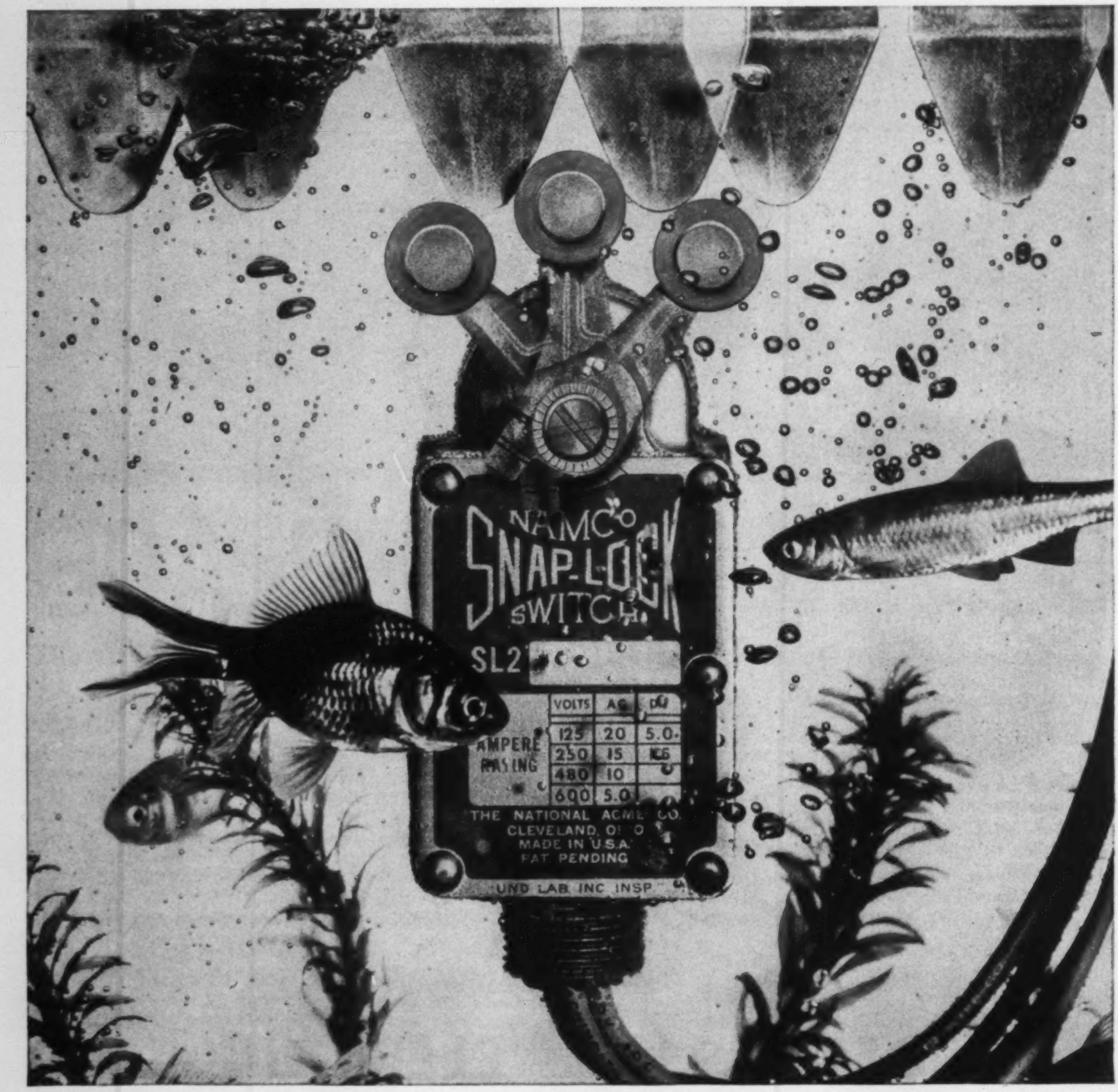
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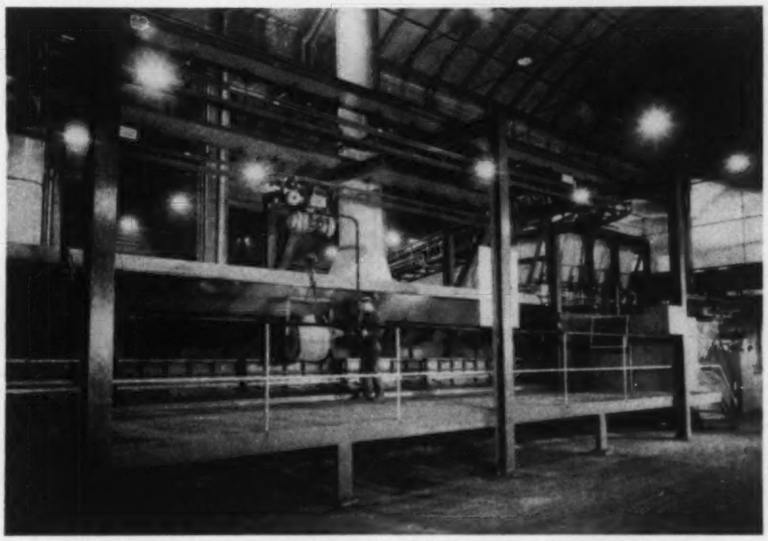

Sand castings for heating boilers are produced in volume with this integrated production system for molding, pouring, cooling, and shake-out in a foundry at Jonkoping, Sweden. Prepared sand is supplied by an automatic sand mixing unit. At maximum operational speed in the foundry, the same sand is used three times a day. Operator is shown positioning a ladle above a flask prior to pouring. Photo supplied by Swedish International Press Bureau and American-Swedish News Exchange.

Designed for Production

CASTING large boiler sections by the sand mold process is a continuous production line operation at the Norrahammar Works of Husqvarna Vapenfabriks A.B. near Jonkoping in Sweden. In the highly mechanized plant, 11 operators produce a volume of products that formerly required some 50 workers. Other benefits of the system include improved, more uniform quality of castings, less scrap, and closer product tolerances.

A feature of the installation is an integrated production line called "Nora Transfer." Functions performed on this line include the basic foundry operations of molding, pouring, and shake-out. In addition, handling devices transport and manipulate the molding flasks so as to maintain continuous flow production. The entire process is supervised from a master control panel.

In operation, a flask is lowered onto a car on which a pattern plate is placed at a molding station. The flask is then filled with about 1.5 cubic meters of sand prepared by an automatic mixing unit that has a capacity of 90 to 100 cubic meters per hour. Following the filling operation, the flask is moved under a pressing head where the sand is automatically molded by pressure from a double rubber membrane machine. Air pressure at 100 psi is applied above the membrane to press the sand down into the flask with a total force of about 140 tons.

Flasks that have been pressed are next conveyed to a turnover station where the drags are automatically inverted and moved to a core setting line. On this line, cores and chaplets are placed manually in the drags with the aid of fixtures. The molds are then closed automatically and a weight is set on top of each assembly. The weight is removed after pouring has been completed in the next step. In pouring, an operator uses an electrically powered, overhead crane to position a tiltable ladle along a line of flasks.

After pouring has been accomplished, the flasks move through a cooling chamber in a total time of 50 minutes. Then, they are transported to shake-out machines that remove the sand from the flasks. During the drag shake-out operation the castings fall out of the drags and are transported to a cleaning shop. Emptied flasks are recirculated to the molding station at the beginning of the line. In a normal day's operation at full casting capacity, each flask completes five to six circuits through the system.

Company engineers designed the system, which has a productive capacity of about 10,000 tons of castings per shift. Swedish equipment is used primarily, with the exception of the rubber membrane pressing machine which was supplied by the U. S. firm, Taccone Corp.

Milan, Italy

Recently organized *Italian Commission for Automation* will function within the National Council for Research (C.N.R.) in Italy. The body replaces a Commission of Study for Automation that was formed in May, 1956.

According to the Italian publication *Automazione E Automatismi*, tasks assigned to the new *Commission* include:

- Study of scientific problems connected with automation, with partic-

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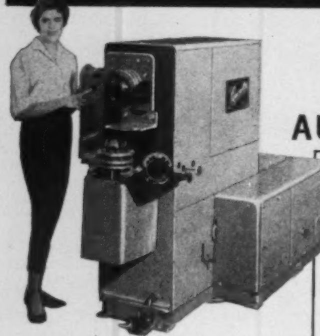

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Circle 674 on Page 19

ular regard to automatic control and computation.

- Review of techniques and applications regarding the introduction of automatic equipment and its use in production. Scope will include operating, organizational, and administrative functions.
- Survey of economic and social implications of automation and progress of technical developments.
- Give counsel to organs of the State in matters of automation.
- Gather and publish an adequate documentation on the state of automation in Italy, with mention of related problems in various sectors.
- Promote Italian participation in international automation activities; in particular, appoint an Italian committee to the International Federation of Automatic Control.

London, England

Measuring the temperatures of wires moving at speeds from 50 to 3000 fpm is the function of a portable instrument developed by Addison Electric Co. Ltd. in conjunction with the British Iron & Steel Research Association. A reading is taken by pressing two pulleys (made of different materials to form a thermocouple) against a wire. The resulting electric signal is fed to a measuring unit, and the temperature is indicated on a meter.

Istanbul, Turkey

Economy and industrial self-sufficiency of Turkey were recently given a boost by construction of an automated, hardboard manufacturing plant near Istanbul, according to Link-Belt Co. The facility, owned by Elka Co., produces 4 by 8 foot, 1/10 to ⅜ inch thick sheets that are smooth on both sides. Steps in the dry process used include chipping of wood logs, screening, steam cooking with wax added, grinding, blending of fiber and resin, and felting where a mat is laid. The mat is then cut into lengths and side trimmed automatically, and the resulting sheets are hydraulically compressed in a hot plate press. After humidification, finished hardboards are delivered to storage. The plant was engineered by Industrial Development Co. Inc. with much of the machinery and equipment furnished by Link-Belt Africa Ltd. Capacity is 50 metric tons of hardboard per 24 hour day.

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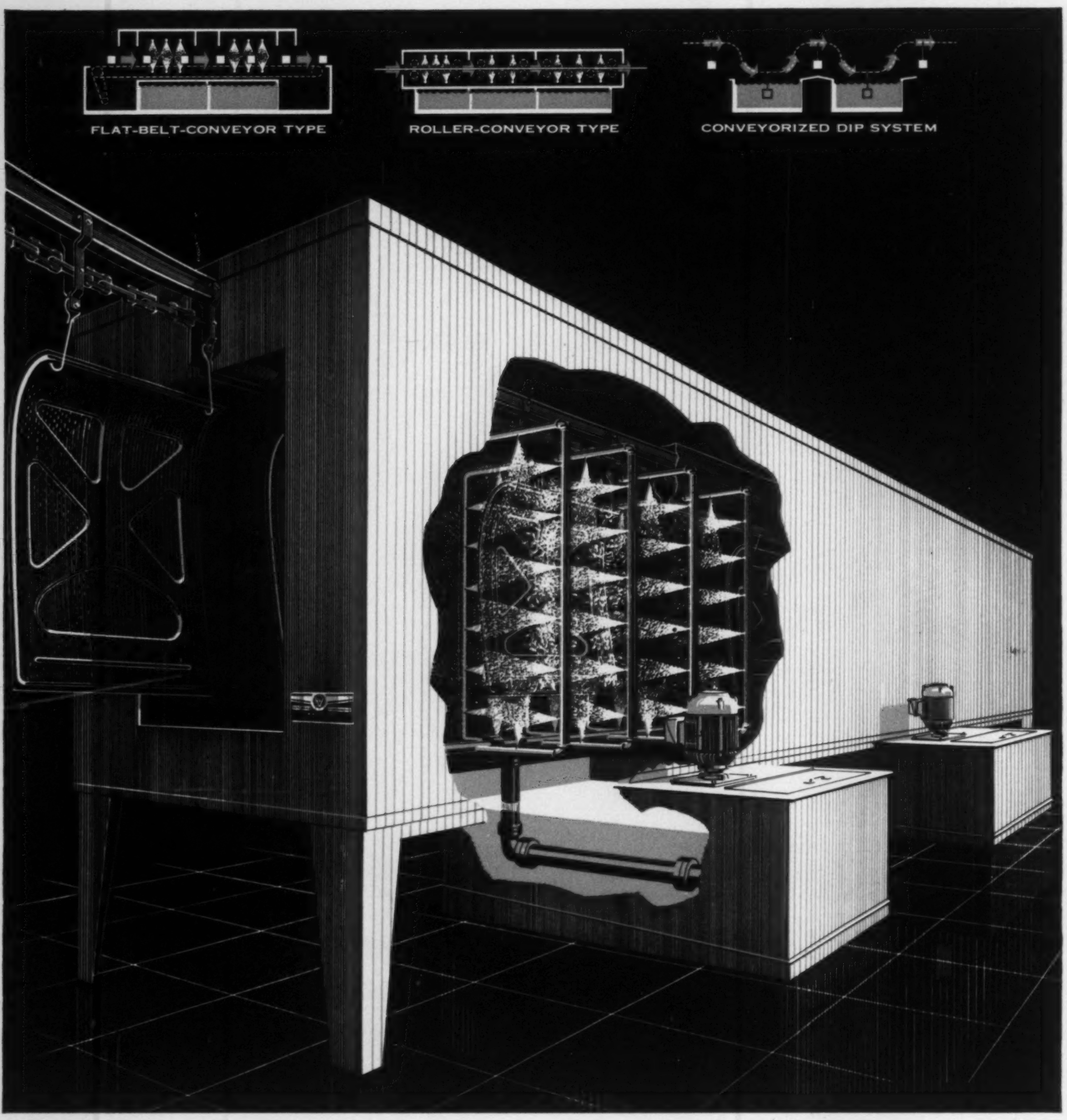

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AUTOMATION

JULY 1961

None Too Good

AVOIDANCE of unscheduled downtime is one of the primary concerns of all personnel connected with the specification, design, building, and operation of automatic manufacturing equipment. To achieve optimum performance it is not only necessary to maintain the production machinery in good working order, but it is essential that it be made of substantial stuff in the first place.

Manufacturing engineers who are called on the carpet to answer for production delays caused by the failure of a "simple component" soon learn the significance of the expression: "The best is none too good." The components of production equipment—be they electrical, hydraulic, pneumatic, mechanical, or electronic—form the links of a chain of reliability that is vital to satisfactory operations. Selection of less-than-the-best for any of these links is an invitation to trouble that could be avoided.

The characteristics that constitute the best component for any particular application are in the province of engineering study. Simple overrating of all requirements is not the answer. Factors of size, weight, inertia, and dynamic attributes must be consistent with the design requirements of the equipment system. To merely make it "hell-for-stout" may be to make it unworkable. Trends in production equipment design are toward more narrow engineering specifications of components. This means that components suppliers are being required to put more exacting ratings on their wares and to deliver merchandise that performs as rated.

Durability of materials and craftsmanship of construction are contributing factors in service life that are usually reflected in the original purchase price. But these also have a pertinence to the long-run cost of ownership. Equipment builders who cut construction costs by supplying cheap components on original production equipment soon become classed with the fly-by-nighters in the minds of machinery users who have learned not to be penny-wise and pound-foolish.

Wise component suppliers who have recognized that the automation market for production equipment has vast potential in processing machinery, handling equipment, and control systems are designing new components and redesigning old lines with the customer's needs in mind. They consider the plant using the automated machinery to be the ultimate customer and are studying the needs at that level. This attitude recognizes that for automated equipment the best now available is none too good, and tomorrow's will thereby surely be better.

James C. Keebler

EDITOR

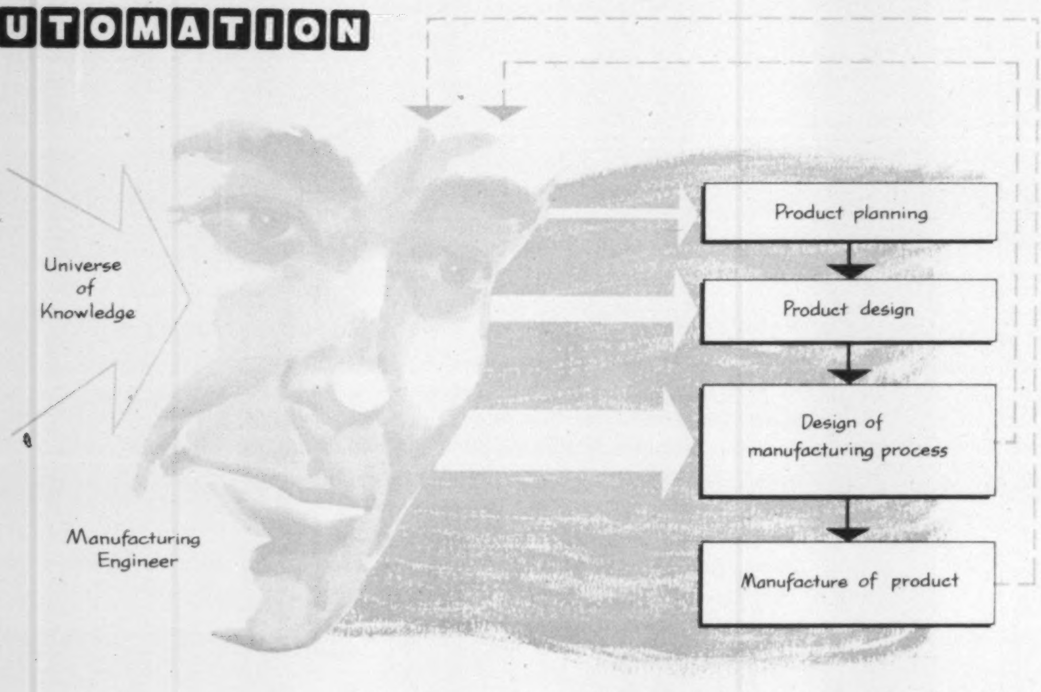

Fig. 1—Function of manufacturing engineering is to explore the universe of knowledge and draw from it for the improvement of the product and production portion of a business. With its responsibility for determining how products will be made, it can open new vistas in product planning, product design, design of processes, and manufacturing of products.

MANUFACTURING ENGINEERING TODAY

By **CHARLES W. MORSE,** Consultant—Manufacturing Engineering Operations
Manufacturing Engineering Service, General Electric Co., Schenectady, N. Y.

MANUFACTURING ENGINEERING has been with us since prehistoric man chipped out the first axe-head, and it will be with us in the highly automated industry of tomorrow. However, the role and scope have changed greatly. Not over ten years ago, manufacturing engineering was in the planning and wage rate area. But as it progressed, it took on new responsibilities and assumed a new aggressiveness and determination in its continuing attacks on costs by finding better ways of manufacturing products.

Manufacturing engineering, with its responsibility for determining how products will be made, is in a unique position. It is able to bring about major improvements in manufacturing and cause changes in the product design that drastically reduce costs and increase profitability.

▶ Control Point

This major role of manufacturing engineering can be understood if it is thought of as a control point, *Fig.* 1, between the universe of potentially applicable knowledge and the product-production portion of a business. The universe of knowledge includes accumulated industrial experience, new science, and new technology. These are explored imaginatively. Determination by manufacturing engineering of ways in which these advances can be applied opens new horizons for planning of products by marketing activities, designing of products by engineering groups, and designing of manufacturing processes and producing of the products by manufacturing entities.

With this understanding of manufacturing engineering's impact, let us see how it fits into a business system. The three primary functions in the product-production portion of the business system are marketing, engineering and manufacturing, *Fig.* 2. The marketing groups determine customer needs and wants, and plan which products will be made. Engineering activities design and specify the planned products. Manufacturing groups specify how products will be made, obtain the necessary facilities, and operate them to produce the products which are then delivered to marketing groups for distribution.

Within the manufacturing activities are the subfunctions of manufacturing engineering, quality control, materials, and facility operation, *Fig.* 3. Plant engineering and manufacturing administration may be separate components in large businesses or multiplant locations.

Note that the circles overlap in *Fig.* 2 where communication and co-operative action take place. In this overlapping area at the center, all three functions must integrate their plans for maximum total effectiveness.

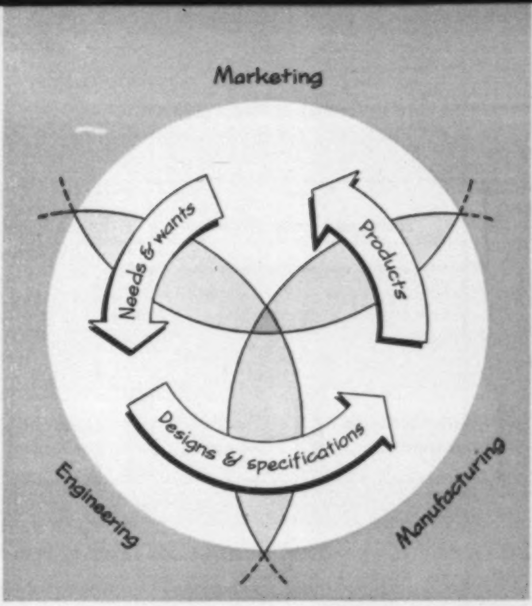

Fig. 2—Product and production portion of a business system includes three main functions. Marketing determines needs and wants, and plans which products to make. Engineering establishes designs and specifications for the products. Manufacturing, with its subsidiary function of manufacturing engineering, obtains required elements and produces the products.

▶ Basic Responsibilities

Within a business structure, manufacturing engineering's basic responsibility is to plan, design, procure, and set up in economic operation the optimum facility for production of present and future products, and to provide technical support to facility operation. This is a definition of manufacturing engineering and also describes the role manufacturing engineering plays in the business system.

Close consideration of this definition reveals that manufacturing engineering has the responsibility to:

1. Specify the processes by which products will be made.
2. Develop and design tools and equipment required by these processes.
3. Establish methods by which tools and equipment will be used.
4. Provide the facilities in accordance with long-range and master plans. The facilities include those tangible items used in, but not consumed by, the manufacture of products. They consist of equipment, tools, and buildings, served with the necessary utilities. An optimum facility implies an integrated operating system which serves the needs of all components. The facility must continue to serve for future products with a high degree of utilization, low operating and maintenance costs, and minimum future investment or conversion expense.
5. Help solve operating problems.
6. Conduct long-range planning and development to continually improve costs by optimizing investments and adapting new ways of manufacturing to the needs and opportunities of the business. This activity, because of its perception and freedom from "fire-fighting," helps give over-all direction to the short-range activities.

The areas of technical responsibility underlying all the work areas and programs of manufacturing engineering include processes, equipment, tools, methods, buildings, and utilities.

Processes include related actions involved in accomplishing a desired end result. They can apply either to the actual manufacture of material, parts, or products—or to related activities, such as planning, design, or administration. Equipment covers the machinery by which manufacturing processes are performed. It includes machine tools and other processing mechanisms, as well as furnaces, test apparatus, material-handling trucks, and conveyors.

Tools are the devices that adapt either the worker or the equipment to a particular material or product

Need for increased technical effort in analyzing and solving manufacturing problems is widely acknowledged. Based on experience in a corporation which is a leader in such efforts, the author discusses the concept of manufacturing engineering—its place in the business organization, its responsibilities, and its range of work.

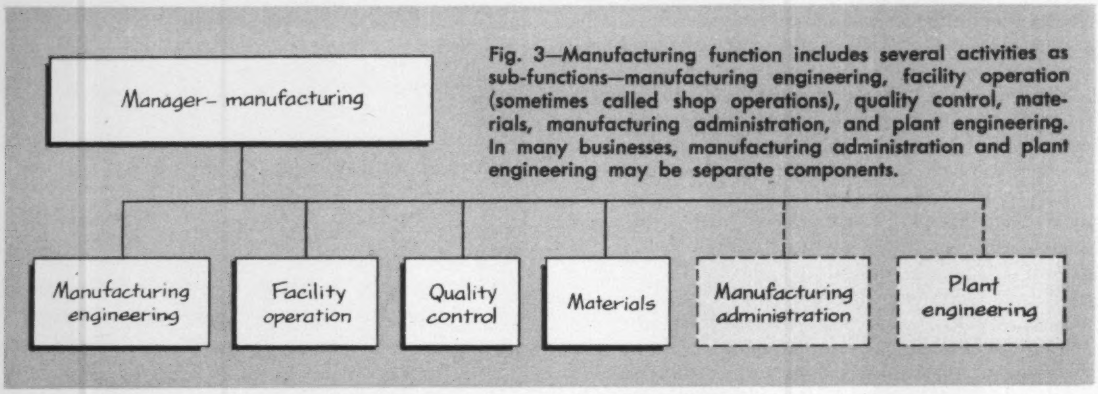

Fig. 3—Manufacturing function includes several activities as sub-functions—manufacturing engineering, facility operation (sometimes called shop operations), quality control, materials, manufacturing administration, and plant engineering. In many businesses, manufacturing administration and plant engineering may be separate components.

component and make its processing possible. Methods are the prescribed ways of doing work. This also includes work measurement and wage administration. Buildings and utilities house and serve manufacturing operations and related activities.

▶ Flow of Work

There is a definite flow of work in a manufacturing organization as shown in *Fig.* 4. This flow is most apparent in businesses where there are frequent and major changes in product design, processes, or facilities. Inputs from the outside and from the rest of the business flow to the engineering group. Product specifications are developed and transmitted to manufacturing engineering activities.

Manufacturing engineering has the underlying band of technical responsibility and the charter to determine how the product will be made; that is, with what processes, equipment, tools, methods, buildings, and utilities. The facility operation (sometimes called shop operation) uses labor and materials to produce the product, subject to controls on quantity, quality, and cost. Technical support is provided to the facility operation as required.

The over-all picture of manufacturing engineering work can be separated into two broad categories. These categories are: 1. Short-range work. 2. Long-range planning and development.

Short-range work determines how a specific product will be made and how to provide the means of making it. Day-to-day "fire-fighting" is included as well as short-term project work. This project work must be done within time limits—between the time the design is released for production by the engineering group and the date when production by the facility operation group is to begin.

Specific short-range work areas are pre-production planning, facility design, facility procurement, and technical support. Note that we are talking of work classifications and *not* organization. These classifications help identify the work for which manufacturing engineering is responsible—its role. To accomplish this work, many variations of organization structure can be used.

Pre-Production Planning: This is the initial short-range activity that determines the course of action for manufacturing. It determines how each part or component is to be obtained. Alternate ways are conceived, and selection of the lowest cost way is made within limits of time or other parameters. Selection is based on such considerations as: Comparative manufacturing costs; comparative costs of make versus buy; available capacity in present facility; cost and time to obtain new facilities; availability and cost of talents and skills; long-range plans, risks, and future needs; and established goals and objectives.

Recommendations may be made to the engineering groups to change the product design, either for better adaptability to present processes or because new processes, equipment, or methods will result in cost improvements.

Other primary outputs of pre-production planning are: Make-buy analysis to determine items to be purchased; detail operation planning for work to be done by facility operation, including process and method specifications; over-all plan of operation; and requirements for new, expanded, or changed facilities.

Facility Design: The facility design function evaluates the requirements for new, expanded, or changed facilities. It determines an appropriate course of action and develops the specifications in detail.

The facility design is documented in plans, schedules, drawings, specifications, plant layouts, and investment proposals. The outputs of facility design—whether for tools, equipment, or buildings—include: Designs and specifications of equipment, tools, and buildings (including their performance and costs); operating and maintenance instructions; schedules for procurement activities (including rearrangement); and proposals for action (including requests for funds).

Facility Procurement: Activity of facility procurement begins with the approval of specifications and authorization of funds. It continues until the facility is established in production and performing according to design specifications. This is a critical spot and one at which many good facility projects have foundered.

In the master pre-production timetable, there is provision for: Soliciting and evaluation of proposals; placement of orders; rearrangement of plant areas; preparation of foundations, buildings, or utilities; installation of equipment; and tryout and debugging (including pilot production). Procurement may be from within the organization, as for tools or special equipment. Building or utility rearrangements also may be done internally, rather than by outside contract.

Technical Support: The final area of short-range work is technical support to the facility operation for problems that are beyond the scope or capabilities of shop personnel. This work includes correction of fundamental difficulties, provision for temporary ways to prevent interruption of production, and the training of operating personnel.

▶ Long-Range Planning and Development

The second category of manufacturing engineering work is long-range planning and development. This sometimes is called advance manufacturing engineering, manufacturing research, or manufacturing development, with a connotation of being ahead of current needs, both in time and in technology. It is both perceptive and selective because it perceives the areas of greatest need or opportunity and then selects alternatives to obtain maximum benefit. From the perspective it has of fundamental needs and opportunities, it prepares master plans or guides for work in the short-range areas.

Long-range planning and development include responsibilities to: Identify needs and opportunities; search for new ways; develop technical and economic feasibility; design alternatives; evaluate and select alternatives; schedule and lead major projects; and develop long-range and master plans (including systems aspects).

Project work, separated from the confusion of day-to-day work, is given continuity of leadership from concept to completion. The achievement of integrated results in major programs is enhanced by the objectivity and perspective of the long-range activity.

The major opportunity areas for manufacturing that get their impetus from long-range planning and development are producibility, vertical integration, and innovation. Their impact is on costs through the areas of product, material, processes, methods, and equipment. The three opportunity areas indicate the extended scope of manufacturing engineering work and show the need for competent technical personnel—for more professional performance.

Producibility: This is a product attribute, as is reliability. When one designs for producibility, he should introduce manufacturing process knowledge into the product development cycle as early as possible so that the product can be designed to be manufactured at an optimum cost from the over-all business viewpoint. This requires experience with existing facilities, as well as search by manufacturing engineering people for new ideas and ways of doing things.

It also requires the development and proof of technical and economic feasibility of processes in time for the knowledge to influence design descisions. It further demands good communication—a thorough interchange of information with the product engineering group. Teamwork, based on mutual respect and proved capability, is vital for success. Pro-

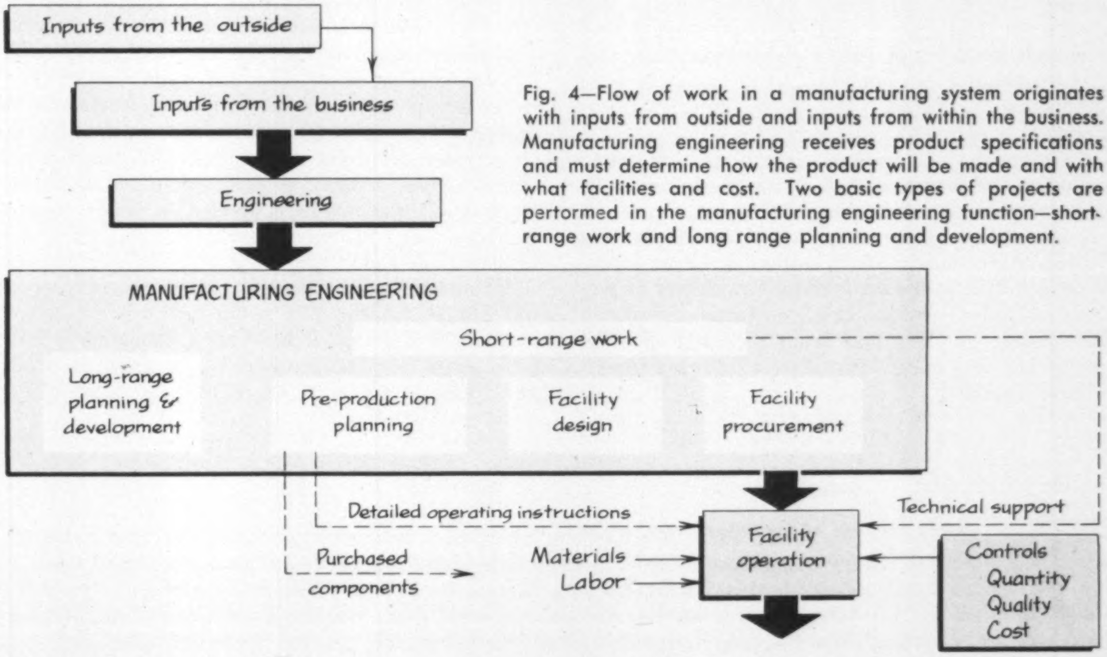

Fig. 4—Flow of work in a manufacturing system originates with inputs from outside and inputs from within the business. Manufacturing engineering receives product specifications and must determine how the product will be made and with what facilities and cost. Two basic types of projects are pertormed in the manufacturing engineering function—short-range work and long range planning and development.

THE AUTHOR

CHARLES W. MORSE is consultant-manufacturing engineering operations of General Electric's Manufacturing Engineering Service.

He has been with General Electric since 1948 in various manufacturing assignments. Just before moving to Schenectady he was manager of manufacturing engineering for the Portable Appliance Dept. in Allentown, Pa.

Mr. Morse's formal education includes a BS in Mechanical Engineering from the University of New Hampshire in 1948 and an MS in Industrial Engineering from Lehigh University in 1959.

ducibility gives impact on costs through the product design.

Vertical Integration: Extension of manufacturing, either toward the customer in the form of end products or toward more basic input materials, is vertical integration. Integration toward more basic materials, the greater opportunity in most cases, involves making materials or components that are usually purchased. Projects of a long-range nature can drastically reduce the cost of materials, now the biggest single item of cost in most products.

Ideas and information about novel approaches and new processes or equipment will come from perceptive search by competent manufacturing engineering personnel. Vertical integration requires process and equipment development to prove the technical and economic feasibility of various alternatives. Creativity and imagination are important at this stage because production is designed from the resulting specifications.

Investment, a long-term commitment, is based on designs of process and equipment which must be able to produce economically for many years. Although there may be savings in merely duplicating within the company what vendors are now doing, a contribution to the art is usually necessary to prevent early obsolescence. It is economical and wise to incorporate the best and latest technical developments into any integration projects requiring significant investment.

A final requirement is leadership. Manufacturing engineering provides leadership to conceive, design, and implement these major projects whose impact on costs is primarily on material.

Innovation: The imaginative adaptation of existing or new processes, equipment, or methods offers a continuing opportunity for cost improvement. Innovations are possible when neither the product nor the material is basically affected. From the long-range planning and development activity can come those new ways to be installed in the facility operation at the optimum time.

Imagination and aggressiveness are both required. Manufacturing engineering must bring imagination, as well as the necessary technical talent, to bear on manufacturing needs and opportunities. Also, it must be a dynamic force in the reduction of available technology to practical application.

Concentration of competent people, free from involvement in "fire-fighting," will insure professional performance. A professional team, operating in the manner described, will make a significant contribution to improved profitability through improved costs.

▶ Why Today's Concept?

Why is this particular concept of the role and scope of manufacturing engineering more satisfactory than some of the concepts used in the past? The primary reasons are: A single organization is responsible for determining how to make the product. This organization is responsible for both planning and implementation. All the required technologies are in this organization. There is a distinct separation of long and short-range work. There is optimum specialization. Aggressive and directed search is an integral part of the work. There is direction supplied by adequate long-range planning. Scope of the work is extended in time, technology, and in range of chartered activities.

Manufacturing engineering has undergone significant changes in its role and scope, particularly in the area of long-range planning and development. Today, it has a stronger organization which is based on sounder principles and staffed with more competent people, is more professional in its approach to its work, uses more engineers with increasing effectiveness, and has more significant programs, both in magnitude and in scope.

Manufacturing engineering is moving ahead under the competitive stimulus to produce new or better products at less cost. It is bringing about major improvements in manufacturing. It is playing a vital and challenging role for the success and profitability of the entire business.

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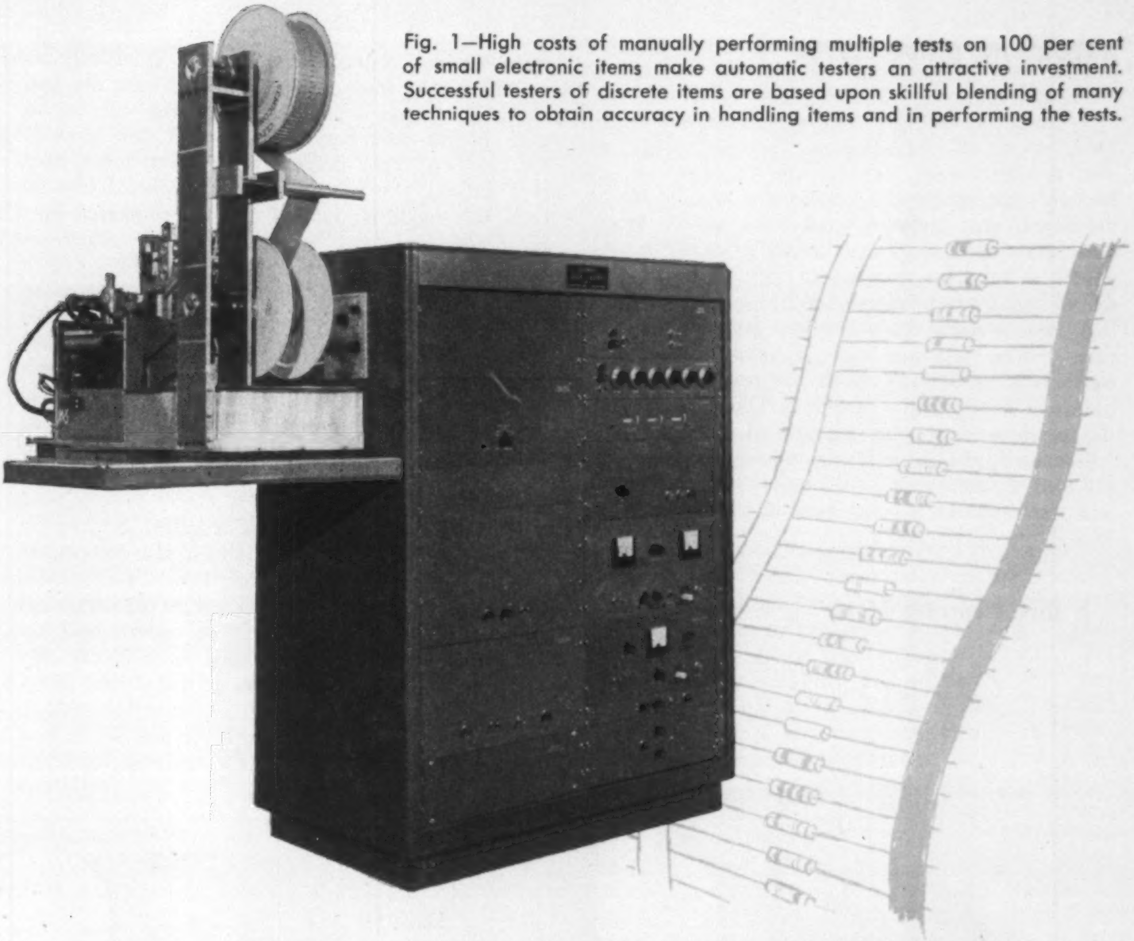
Fig. 1—High costs of manually performing multiple tests on 100 per cent of small electronic items make automatic testers an attractive investment. Successful testers of discrete items are based upon skillful blending of many techniques to obtain accuracy in handling items and in performing the tests.



AUTOMATIC DIODE TESTER

IMPROVES PRODUCTION YIELDS

By **PHIL W. BECK**, Operations Manager, Contronics Inc., Boston, Mass.

AMONG the production problems confronting the electronics industry, both manufacturers and users, is the need to individually test many small components. In attempting to obtain assured performance in the end-items built from the components, the industry typically uses manual testing techniques, acknowledged wasteful of both effort and product. With the growth of sizable new markets, such as the computer field, and shrinking profit margins, the electronics industry has turned to automatic test equipment in order to improve production operations.

This trend is exemplified by equipment developed by Contronics Inc. to test diodes, components widely used in computer circuits. The tester is designed to handle diodes which are taped and reeled, to cut diodes from the tape which fail dc tests (forward saturation voltage test and reverse leakage test), to cut diodes from the tape which fail an ac test (measurement of recovery characteristics), and to rewind the tape with accepted diodes remaining. It is only necessary for an operator to load and unload the reels and to start each new tape into the testing machine. Thereafter, the process is automatic.

Mercury cells are used as a standard of measurement in the machine which goes through a detailed self check prior to testing each diode. Accuracies of one per cent are assured. Should the machine fail to pass the internal self test, it will stop and a machine fault will be indicated. This means that customer specification guard band allowances for equipment inaccuracies can be eliminated and only a guard band large enough to accommodate diode drift and instability need be used —with a resultant increase in yield of acceptable diodes from a group being tested.

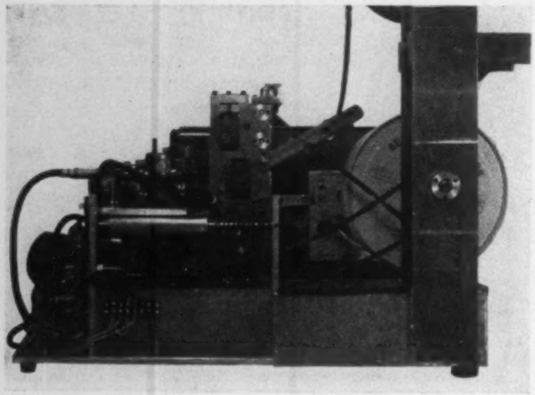
As stated each diode receives both dc and ac tests. These tests are made at upper and lower test points simultaneously as the taped diodes are indexed through the machine. Diodes failing a test at either test point are severed from the tape and blown into a reject container. Counters on the control cabinet total the number of diodes tested and the numbers rejected because of the dc or ac tests.

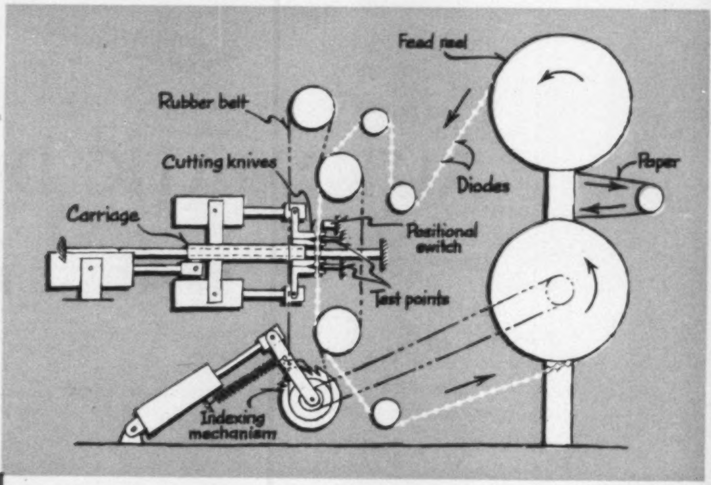
Direct Current Tests

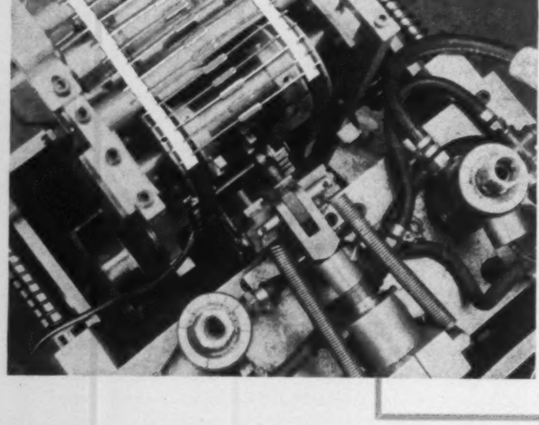
Included in the control cabinet is the forward saturation voltage test unit which supplies a forward current continuously variable from 0.7 ma to 180 ma in four current ranges. There are two rheostat controls which can vary the current in each of the two lower ranges, and one rheostat for the two upper ranges. With the required current settings, the forward voltage measured directly from the anode of the test diode is compared to a preadjusted reference voltage level and either an accept or reject signal is obtained.

The reverse leakage current test unit supplies voltage (reverse) which is continuously variable from 0 to 100 vdc. The leakage current is then measured by measuring the drop across a high resistance, which is small compared to the resistance of the reversed-biased diode. The measured voltage is compared to the proper reference voltage level, and either an accept or reject signal is obtained.

Each of these two dc tests is called in turn by a separate test control panel which also remembers a reject produced by either of them. In the event of a reject, a signal is sent to an electromechanical control panel, causing a relay to operate and actuate the pneumatically operated knife blades that sever the diode from the tape at the dc test point.







MACHINE OPERATION

GENERAL sequence of operations of the diode testing machine is as follows: Diode strip indexes one position forward; carriage supporting test leads and knives closes upon diodes to be tested; electrical tests are made simultaneously at upper and lower test points; knives cut rejects from diode strip upon signal; and carriage retracts for next cycle. The machine cycles at the rate of one diode per second.

As shown by the diagram, reels of taped diodes are supplied with a paper interleave between adjacent layers of

▶ Alternating Current Test

The technique for automatically performing the recovery time test is a unique feature of the machine. Of presently known methods for measuring the recovery characteristics of diodes, two methods are the most widely used. Both consist of prebiased diodes in the forward conduction region along with a prescribed current. One method called the JAN 256 type measurement consists of a circuit which switches the diode across a reverse voltage source and involves measuring the current waveforms across a load resistor in series with the diodes. The other method called the Storage Charge method, consists of a circuit which switches the diode from the forward conducting state to a reverse current source. The current flowing out of the reverse current source provides the output waveform.

The JAN type method suffers from the fact that the circuit is not accurate below 0.1 micro second. The fall time of the normally used 50 kc square wave generators is too slow for higher speed measurements. Also, the voltage drop across the series load resistor must be clamped, or limited, to a small value when the diode is in forward conduction. The difficulties encountered in obtaining a high speed clamp whose input capacitance is low have not to date been solved to a satisfactory degree.

As far as the circuit designer is concerned his choice may have to be made on the basis of the speed his gates must work, rather than his preference for a voltage-time relationship given by the JAN 256 type measurement, or for a total charge "leakage" through his gates such as the stored charge measurements will provide. High speeds dictate the adoption of the stored charge method or the solution to the problems associated with the JAN 256 type measurement. The illustrated automatic diode tester utilizes the stored charge technique. The reverse recovery time is measured by "reading" the output of a test unit originally designed to feed signals to an oscilloscope. The output of this unit is amplified and fed to various circuits which determine if the time at which the diode recovers is within the range selected (available ranges are 0-36, 30-75, 75-200, 160-500, and 0-700 nanoseconds).

The input signal is amplified by a dual cathode-coupled clipper and a wideband amplifier employing a secondary-emission pentode. This output is fed to two cathode followers, each driving a coincidence circuit using semiconductor diodes. The trigger signal is amplified and triggers a gate generator employing a secondary emission pentode. This gate drives a coincidence circuit and also triggers a second gate generator.

If the gate and signal arrive at the coincidence circuit within the time range determined by the front panel control, an output is produced which, via the trigger amplifier, will trigger a sensitive multivibrator. In turn, the output of this multivibrator triggers a wide multivibrator which produces, via a trigger amplifier, a long pulse (about 100 microseconds) that is fed to a logic circuit and relay driver.

The second gate generator and its associated circuits are required on the ranges which do not have zero time as a base point. They permit discrimination of diodes which recover earlier than the specified time.

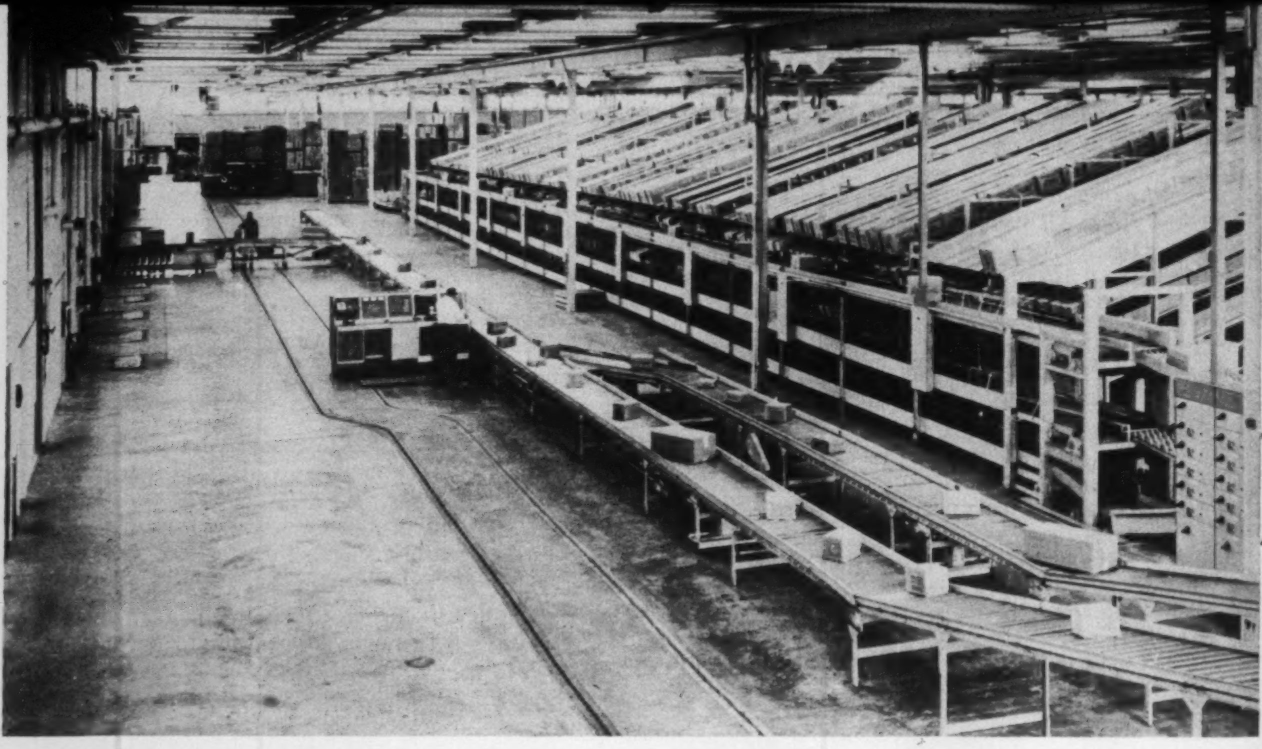
Since three different outputs are possible on the ranges not starting at zero time, a logic circuit is used to permit only the correct combination to yield an accept signal to the relay driver. For example, the ranges 0-36 nanoseconds and 0-700 nanoseconds only operate the "accept" input of the logic circuit if the diode is within limit. If the diode is too slow, no output is produced at the coincidence gate and no accept signal is produced. The intermediate ranges do not have zero as a lower limit and therefore a means is provided to prevent a false accept signal from being produced.

Even though the second gate circuit is not activated until the conclusion of the first gate interval, a signal which rises prior to the second gate interval will activate the second coincidence circuit. However, the first coincidence circuit will also be activated and this output is fed to the "inhibit" input of the logic tube to prevent a false accept signal. Obviously a signal which is later than the specified interval will not activate either circuit and no accept signal will be produced.

diodes. In the testing machine this paper interleave is unwound from the feed reel and rewound on the storage reel, again between layers of diodes. The diode strip is fed between two rubber belts and is pulled along by friction force. Indexing of the belts is accomplished by a ratchet-and-pawl mechanism, which also drives a roller chain linked to the storage reel. Indexing mechanism does not produce a preset incremental motion as in typical applications. Motion is imparted to the belts and sustained until a diode actuates a photoelectric switch positioned above the first test point. The small overtravel of the strip after the switch has been actuated is predictable.

Spacing of the two test points is such that, with a diode stopped by the positional switch, two diodes are in position in front of the test points. Each test point consists of a pair of rods which make pressure contact on either side of the diode leads.

With diodes before the test points, a reciprocating carriage moves into test position. Spring-loaded nonconducting plungers on the carriage apply pressure to the diode leads, holding them firmly against the test points. Scissors-type cutting knives are also positioned relative to the leads of the diodes being tested such that the leads can be cut if the knives are actuated. Should a diode fail a test, it is severed from the tape and removed by a blast of air that blows it into a bin. The indexing mechanisms, carriage motion, and knife assemblies are operated by electrically controlled pneumatic cylinders.



AUTOMATION TODAY

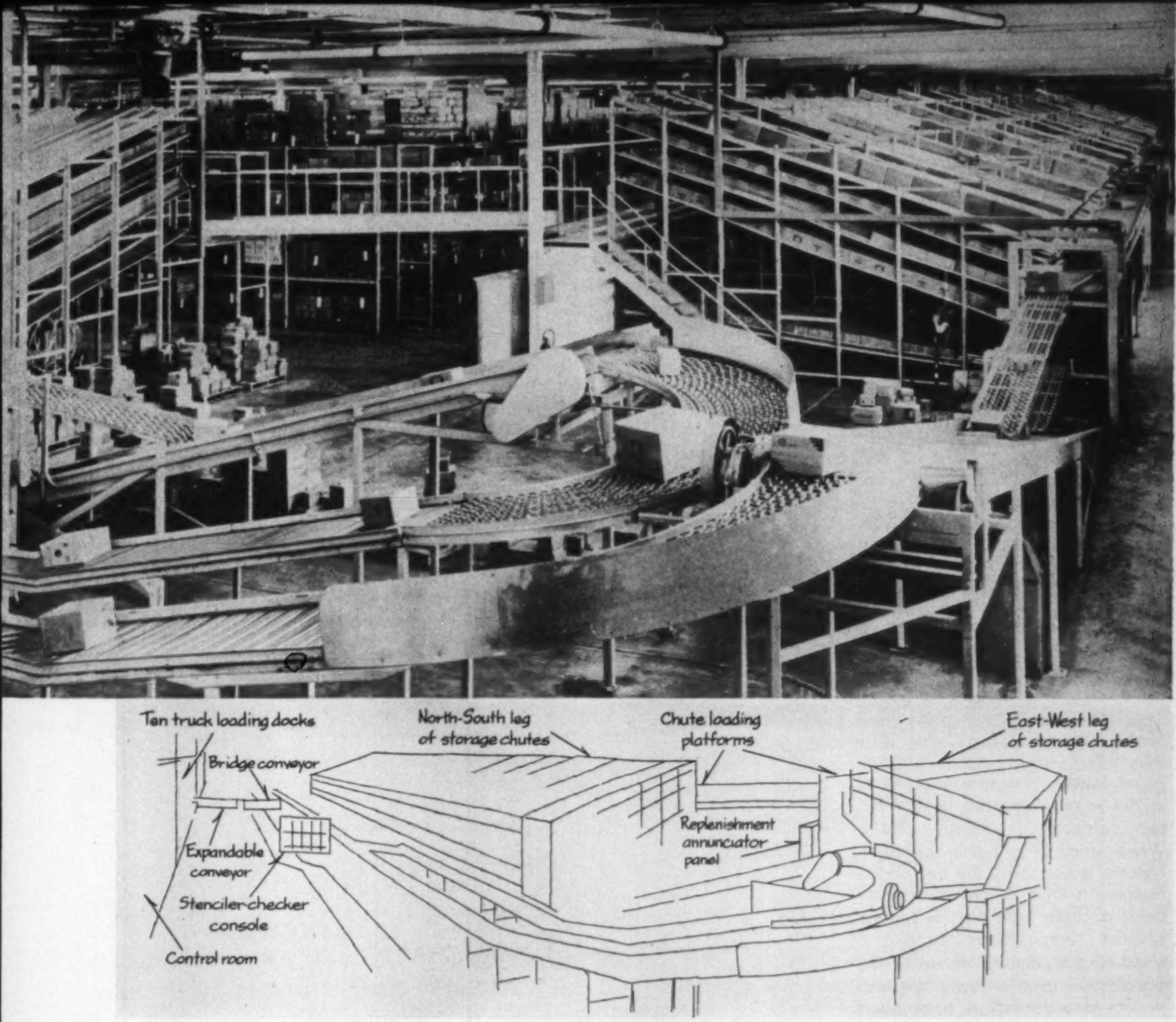
CARD CONTROLLED ORDER-PICKING

SELECTS TRAILER-LOAD SHIPMENTS

MECHANIZED order selection offers many advantages to the company that has sufficient shipping volume to justify the initial investment. In addition to cost savings due to the elimination of manual picking methods, a mechanized system can provide first in, first out turnover of stock; can improve customer service by shortening the time between receipt of order and shipment of goods; can concentrate more goods in less floor space; can allow more efficient use of loading docks; can reduce damage to stock and pilferage of goods to a minimum; can provide better inventory control and more efficient handling of customer paperwork; and can permit accurate scheduling of order pickups by trucking companies so as to eliminate costly trucker waiting time.

With such advantages as a goal, personnel of the Shipping and Central Engineering Divisions of Johnson & Johnson, a major manufacturer of medical and surgical supplies, spent two years in determining what type of mechanized order selection system should be used to replace their existing dragline conveyor, manual picking method. During this time, they visited plants throughout the country to study examples and installations of mechanical order selection, evaluated their own special product requirements, and consolidated their ideas as to what would be an ideal system for their type of operation. The system finally selected was designed, manufactured, and installed by Admos Inc. and is shown in detail in the accompanying illustrations.

The system is called the Admos Mk IV (Automatic Device for Mechanical Order Selection) and is built in an L-shaped layout to occupy one corner of Johnson & Johnson's Shipping Center in New Brunswick, N. J. The long or East-West leg of the system is over 300 feet in length, and the short or North-South leg is over 200 feet in length. Both sections are 36 feet in width. Occupying only 20,000 sq ft of floor space as compared with the 50,000 sq ft used by the dragline system, the system has an over-all capacity of 85,000 cartons of random


Ten truck loading docks
Bridge conveyor
Expandable conveyor
Stenciler-checker console
Control room
North-South leg of storage chutes
Chute loading platforms
Replenishment annunciator panel
East-West leg of storage chutes

1 Panoramic view shows the L-shaped layout of a mechanical order selection system installed in the shipping warehouse of a large manufacturer of medical and surgical supplies. Major components of the system can be located by reference to the keyed diagram. Over-all capacity of the system is approximately 85,000 cases of random sizes and shapes. As many as 1800 cases or pieces can be selected and loaded into trailers in less than one hour.

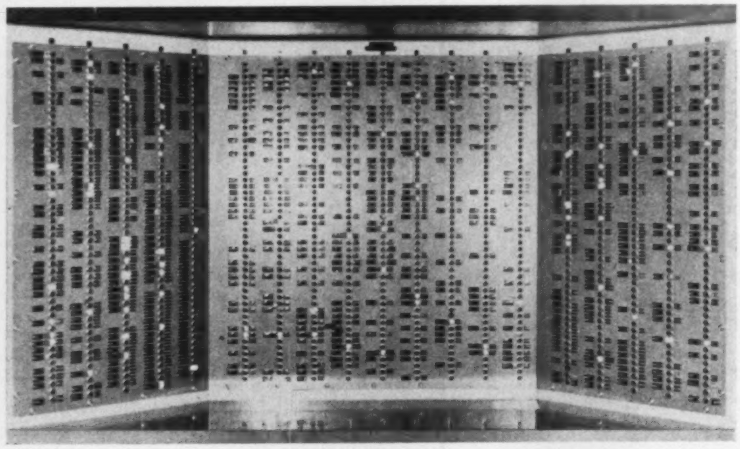
sizes and shapes which hold about 400 different products. Of all the goods shipped from the Center, the mechanized order selection system is used to select 62 per cent which are full cases but less than pallet loads. Pallet loads represent 30 per cent of the total goods shipped and are carried by fork trucks directly to trailers. The remaining 8 per cent of the volume represents less than case orders which are mechanically selected on a smaller version of the large system.

In the large system, cartons are stored on 5 levels of inclined chutes in the North-South leg and on 4 levels of inclined chutes and a level of gravity roller conveyors in the East-West leg. Over-all, more than 2000 chutes are used in the system. The chutes are built in six sizes which vary from 9 inches in width to 30 inches, and each chute is over 27 feet in length. Cartons in the chutes ride on replaceable runners which control the speed of descent of the packages. The chutes can be easily removed and replaced with different size units when product carton sizes change. The chutes have clips on their bottom surfaces which slip over the sides of channels forming the frame of the system. All electrical connections to the empty and replenish switches in the chutes are of the plug-in type to provide ease of changeover or replacement.

Cartons are selected from the chutes and gravity conveyors by means of punched cards and a card reader located in a control room adjacent to the loading docks. When an order is prepared for selection, the product code number is translated into a chute location number, and this numeral and the number of cartons required are entered onto a punched card. Each card controls the release of one particular product, and up to 99 cartons of the product may be selected by a single card. The cards are arranged in proper sequence for selection so that the cartons nearest the exit points of each leg are released first. At the end of each order deck of cards, an end of order card is placed to stop the card reader.

When the order deck has been delivered to the control room, an operator places the deck into the card reader and presses a pushbutton to start the automatic selection of cartons. Through a system of relays, each card actuates a release mechanism at the lower end of a selected product chute and allows the designated number of cartons to move onto carry-away conveyor belts running across the front of each leg of the system. These conveyors move the cartons to an inclined conveyor belt at a speed of 450 feet per minute. Cartons from three horizontal carry-away conveyors of each leg are merged on the inclined conveyor, conveyed to a height of approximately nine feet, and released onto skate wheel turn conveyors. After executing a 90 degree or 180 degree turn, depending upon the leg from which the cartons are being fed, the units are slowed to about 75 feet per minute as they move down an incline and past a stenciler-checker operator.

Aided by a closed circuit television system which monitors the card reader in the control room and a photoelectric counter system, the stenciler-checker operator controls the entire order selection system and guarantees an accurate piece count for each order. As each carton passes the operator, he stamps the unit with a stencil machine that accumulates the total number of cartons stamped. This number is compared with a number appearing on the control panel that indicates the number of cartons released by the card reader and with another number appearing on the panel indicating the number of cartons passing through the photoelectric system. Any items that are in short supply and are not released by the card reader are automatically printed out on the card reader in the main control room. This information appears simultaneously on the screen of the television monitor at the stenciler-

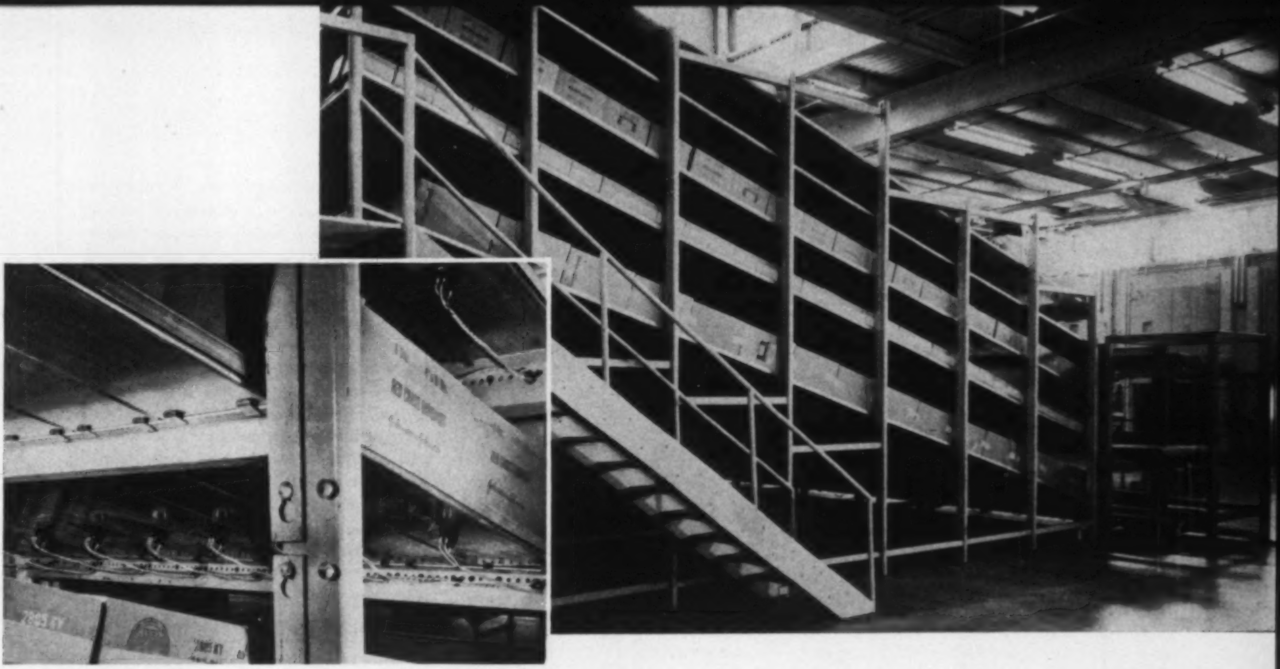


2

Pallet loads of cartons are stored in the warehouse area behind the two sections of storage chutes. When stock in a particular chute reaches a low level, the last carton releases a limit switch which energizes a chute light on this replenishment annunciator panel. A checker periodically observes the panel and uses a radio dispatch system to order a fork truck operator to deliver a pallet load at the rear of the chute needing refilling. The checker then places a small magnet opposite the illuminated chute light and rechecks later to see if the light has been extinguished. When the chute has been filled, the light goes out.

3

As directed by the checker, the fork truck operator places pallet loads of cartons on either of two storage racks at the rear of the storage chutes. The replenisher operator then fills the empty chute with cartons by loading directly from the platform floor for the lower levels or by using a mobile platform for the upper two levels of chutes. The operator also can advise stock control of the condition of any item in the chutes by means of a public address system. Since more than 85 per cent of the chutes carry over a week's supply of cartons, two operators can handle the restocking of the entire system.



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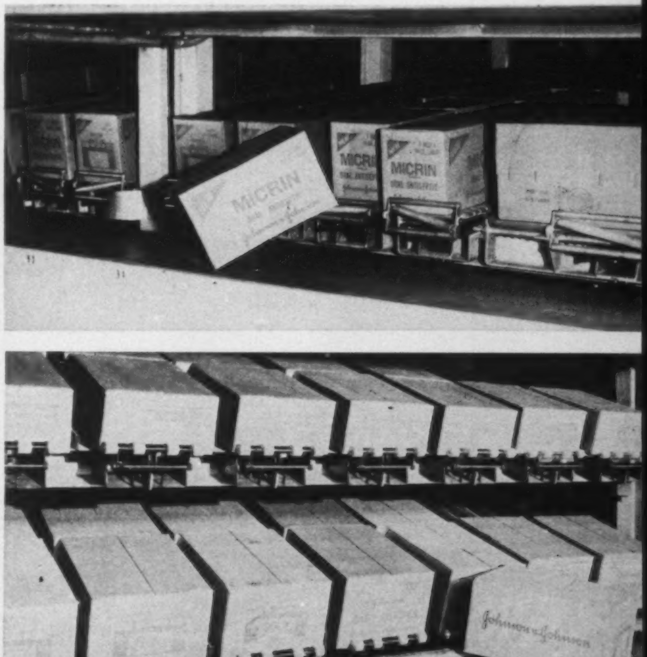
As the cartons are loaded into a chute, they slide on replaceable runners that control the speed of descent. These runners are made of different materials which are interspersed in the chute, depending on the size and weight of a carton being controlled. In this end view of the North-South leg of storage chutes, the loading platform is on the left and the three levels of carry-away conveyors are on the right. The replaceable chutes used in the system are made in six sizes varying from 9 to 30 inches in width and over 27 feet in length. Up to ten chutes can be electrically interconnected to feed one item. Each chute is equipped with an *Empty* switch, inset, which is connected to the main control console. When the last carton in the chute passes over this switch, the wire actuator rises, closing the switch contacts and causing the cartons to start feeding from an adjoining chute containing the same product. The last chute of a series is equipped with a *Replenisher* switch connected to the annunciator panel. If all the chutes in a series become empty, a signal is sent to the control room, and a backorder is printed by a card reader.

checker control panel.

By the use of cube and weight factors, trailer loads of merchandise are predetermined. Order selection and accumulation are accomplished item by item for one trailer load at a time. This permits a trucking company to dispatch a pickup trailer to the warehouse at a definite time and allows the driver to back into a loading dock, be loaded, and leave the warehouse in less than an hour. In normal operation, only two trailers are required to be in the docks at one time. One trailer is being loaded while the second trailer is standing by to be loaded. The system is set to select one carton every



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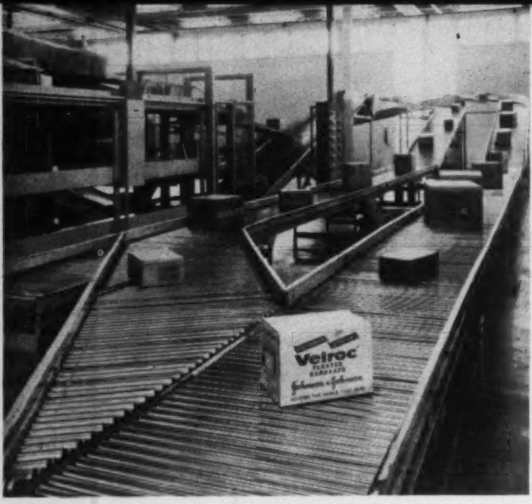
Release mechanisms at the front of the chutes are activated by a punched card reader in the control room. Each card contains the chute location number and the number of cases to be released for the order. Only one card is needed per item, and up to 99 cases can be released by a single card. Cartons that contain fluids or that weigh over 35 pounds are stored on roller conveyors in the lower level of the East-West leg and are released by solenoid-operated windmill release mechanisms, upper view. All other cartons are stored in chutes and are released by solenoid-operated tuck mechanisms, lower view. These release mechanisms vary in design, depending on the size and weight of carton to be released. Items that lend themselves to dropping are placed on the upper level of storage. More fragile or breakable items are stored at belt level and are smoothly released onto the carry-away belt.



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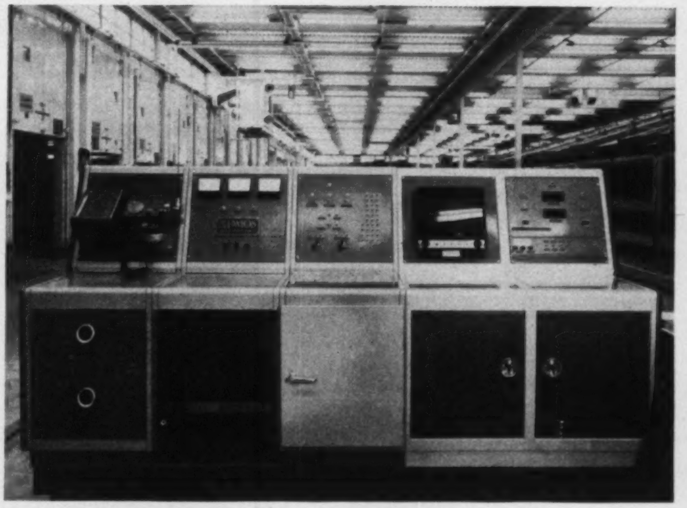
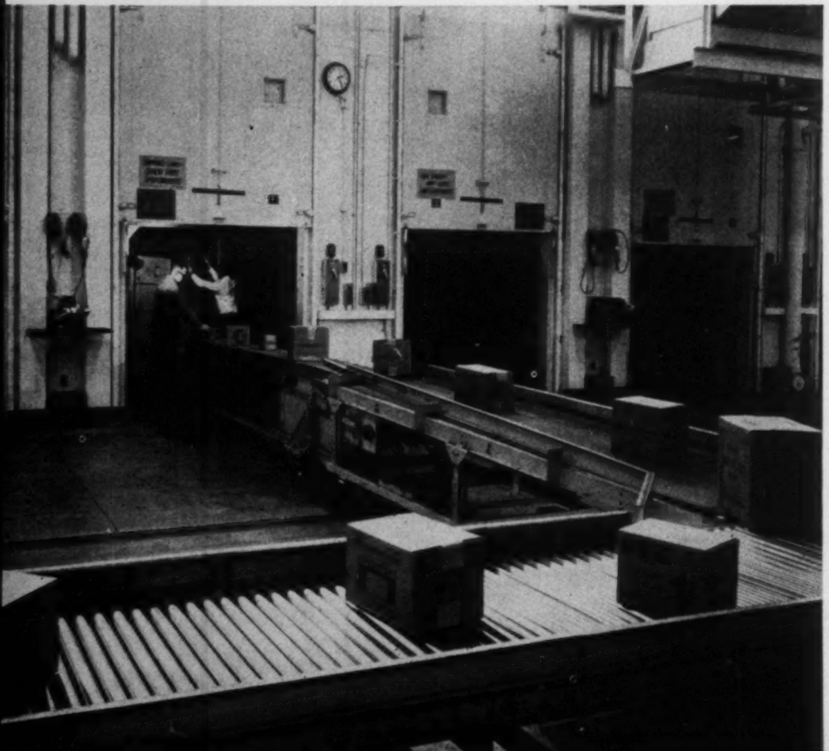
From the North-South leg of storage chutes in the left background, the selected cartons are conveyed along three belt levels to an inclined belt conveyor where they merge smoothly into a single line. At the top of this conveyor, the cartons are ejected onto a live roller conveyor which guides them around a 180 degree turn and down to the checker-stenciling line. A similar system conveys cartons from the East-West leg of the system, around a 90 degree turn, and down to the checker line. In this view, the cartons from the North-South leg are on the left conveyor, and the products from the East-West leg are on the right conveyor. Both conveyors merge into a single line in the foreground.

7

The stenciler-checker console is the central point of operation for controlling the entire system. The operator has direct-line communication with stock control and other strategic locations throughout the warehouse by means of the radio dispatch unit and intercom on the left of the panel. A closed circuit television monitor is connected with a camera overlooking the card reader in the control room and presents information concerning back-ordered items including customer's invoice number, chute location, product code, and cartons short. Comparison counters on the right panel show the number of cartons released and the number of cartons passing through a system of photoelectric cells. These two numbers are compared with a number accumulated on a stencil machine each time it is applied by the operator to a carton. By means of a switch, the entire system can be converted from automatic to manual operation. To manually select cartons, the operator lifts a plastic panel from a keyboard in the center cabinet, inserts carton location and quantity information, and releases cartons at the same speed as does the punched card reader.





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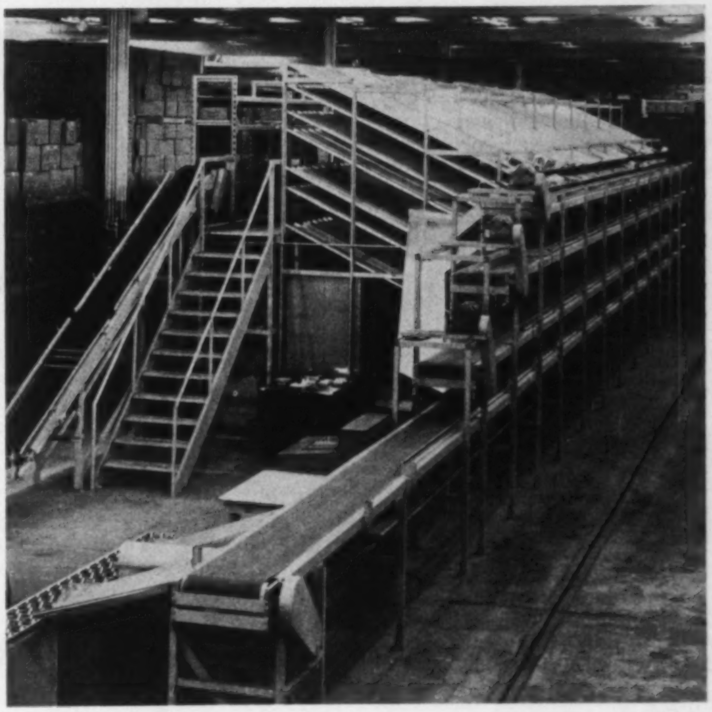
After being checked and stenciled, the cartons are conveyed directly to one of the ten truck loading docks. The connection between the roller conveyor and the trailer is made by a bridge conveyor which can be moved between loading docks on the tracks of the former dragline system. From the bridge conveyor, the cartons move on an expandable conveyor which can reach almost to the front end of a 40-foot trailer. As the load builds up in the trailer, the expandable conveyor is automatically retracted. A representative of the trucking companies usually stands near the bridge and counts the cartons being loaded. He then signs the official bill of lading for each trailer leaving the warehouse, and the load need not be recounted at the carrier's terminal.

9

A small, self-contained selection system is used to handle broken-lot orders. This system has 7 levels of storage chutes, which are 10 feet long and vary in width from 2¾ inches to 12 inches, and handles about 700 items from approximately 920 chutes. It is loaded from the rear in a similar manner as the large system, and products are selected from a manually operated keyboard. Solenoid operated releases escape the products to belt conveyors. On the upper levels, the conveyors move the products to a slide chute on the near end of the system. The products then merge on the lower conveyor and pass in front of the selector operator for inspection and count. Deflectors are placed on the near end of this conveyor to route the products to packers who either place the products in cases for the trailer docks or wrap the products for parcel post mailing.



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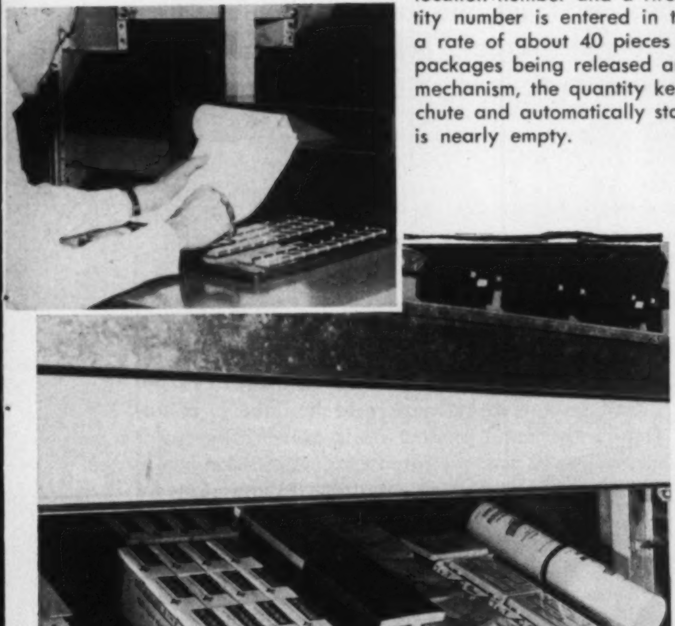
These two views show the selector keyboard and the release mechanisms for the small selection system. Operator reads the order and enters a four-digit chute location number and a two-digit quantity number. As soon as the second quantity number is entered in the keyboard, the system starts releasing products at a rate of about 40 pieces per minute. A lighted readout shows the number of packages being released and when the last product has passed over the release mechanism, the quantity keys pop up. Products can be stored in more than one chute and automatically start feeding from the second chute when the first chute is nearly empty.



two seconds, but can operate at speeds up to 80 cases per minute. This means that as many as 1800 cartons or pieces can be selected and loaded in less than one hour. A 35-foot trailer, carrying an average of 900 miscellaneous cartons, can be filled in about one-half hour.

Under the present operating conditions, the chutes hold at least a week's supply of about 85 per cent of the items stored in the selection system. Less than 2 per cent of the items require a daily stocking of the chutes, and the remainder are refilled 2 to 4 times per week. The large system is used to select and accumulate full carton orders. Less than carton orders and individual package items are selected on a smaller version of the large system. When items from the small selection system are included in a trailer order, the stenciler-checker finds a note to this effect on the bottom of his bill of lading. These items are pre-selected on the small system, packed in cartons, and delivered by fork truck to the stenciler-checker. Many orders selected by the small system are small enough to be shipped by parcel post.

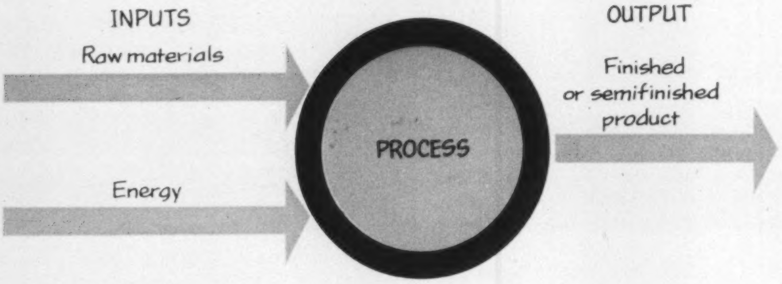


Fig. 1—Simple model of a manufacturing process illustrates how raw materials and energy are combined to obtain a finished or semifinished product. Goal of automatic control is to properly control the process inputs so that the output product will have required characteristics at some desired or optimum cost.

DEVELOPING CONTROL SYSTEMS

FOR AUTOMATED EQUIPMENT

Complex manufacturing operations often involve multiple machines or process stages, each presently using measuring instruments and automatic controllers. The systems approach is applied to integrate individual process stages into an over-all control data system. Such integrated systems make possible both improvement and management cost control.

By **HENRY R. CHOPE**, Executive Vice President, Industrial Nucleonics Corp., Columbus, Ohio

A SYSTEMS approach to the development of complex automated systems is to a large extent synonymous with a systematic consideration of all important factors in a given manufacturing operation. The various factors and items that the system engineer must consider before a decision is reached to automate further are: 1. The process machinery. 2. Characteristics of the raw materials. 3. The existence and ability of devices to measure performance. 4. Automatic controllers that may be applied at various points in the process. 5. Computational, logic, and data storage devices. 6. Process actuators. 7. Materials handling and transfer equipment. 8. The costs of incremental additions to an existing system compared to the expected economic returns.

In the above it is assumed, of course, that automation is in accordance with the general goals of the company's operation. If the company does not intend to stay in business or to continue to manufacture the same product or is anticipating major changes in its process, introducing automation equipment can well produce disastrous results. One of the papers[1] presented at last year's Manufacturing Automation Conference considered these precedent conditions in considerable detail.

Automation today is viewed from many vantage points. It often appears as if each instrument, controller, computer, or materials handling manufacturer views automation as being synonymous with the particular product or service which his company is selling. For example, the instrument manufacturer is prone to consider automation as merely an extension of control based upon his particular

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This article is based on a paper presented at the "Fifth Conference on Manufacturing Automation" cosponsored by AUTOMATION, Purdue University, and the Manufacturing Engineering Council, April 1961.

[1] References are tabulated at end of article.

instrument. Automation to the computer manufacturer may involve the acts of purchasing and installing a very large and costly computer which would then in turn somehow automatically adjust and control all process machinery. The materials handling equipment manufacturer points out—with considerable justification — that often the greatest progress in manufacturing involves merely the application of more mechanization for handling or moving materials. The key to economic and effective application of automating operations involves a balancing of each of the above factors and "hard-nosed" questioning of benefits to be obtained compared to the cost of obtaining them.

▶ Useful Process Models

The analysis of many manufacturing operations can be greatly simplified by creating models of the operation. Different models may be used for a given process, depending upon the particular use for the model. Complex or multistage processes can often be described in terms of combinations of individual models which integrate materials handling devices, feedback controllers, and data processing hardware.

Recently, Dean William Everitt of the College of Engineering, University of Illinois, ventured the observation[2] that if it were to be done over again, the teaching of engineering would probably not be subdivided into the classical areas of mechanical engineering, electrical engineering, chemical engineering, etc. Engineering education, at least, would address itself to the study, analysis, and control of processes involving materials, energy, and information.

A manufacturing process can be viewed in terms of this somewhat simplified consideration of these three basic factors: materials, energy, and information. Such simplification reduces the number of factors to be considered from the eight stated previously to three major items. A manufacturing operation, therefore, becomes a process involving machines or combination of machines for converting energy and materials into a finished product. The product thus manufactured must meet certain quality characteristics and be salable.

A simplified raw material-energy-product output viewpoint of a process is illustrated in *Fig.* 1. The goal of automatic control then becomes that of properly controlling raw materials and energy within the process so that the output product will have the required characteristics at some desired or optimum cost.

Although this model of a process is simple, a more useful model to the systems engineer is one which views a process in terms of its output product characteristics as created by the proper combination of input process variables. This process viewpoint is sometimes referred to as an information input-output model, *Fig.* 2. The input process variables and output product characteristics which are of interest in various processes are listed. Process automation, therefore, involves the proper blending of materials, energy, and information to yield an economic product of required quality.

Among the various product characteristics that are important are thickness, weight, strength, surface condition, chemical composition, and shape or configuration. Which particular combination of product characteristics is important depends upon the particular process being considered and the product being manufactured.

At the input side of the process, the process variables may be subdivided into two categories, namely, those variables which are adjustable and those variables which are not adjustable. In the latter category would be included unknown and random sources of variation which can be considered to cause variation in the output product characteristics. Although these various product characteristics and process variables exist in a physical sense, little can be accomplished to control them until a

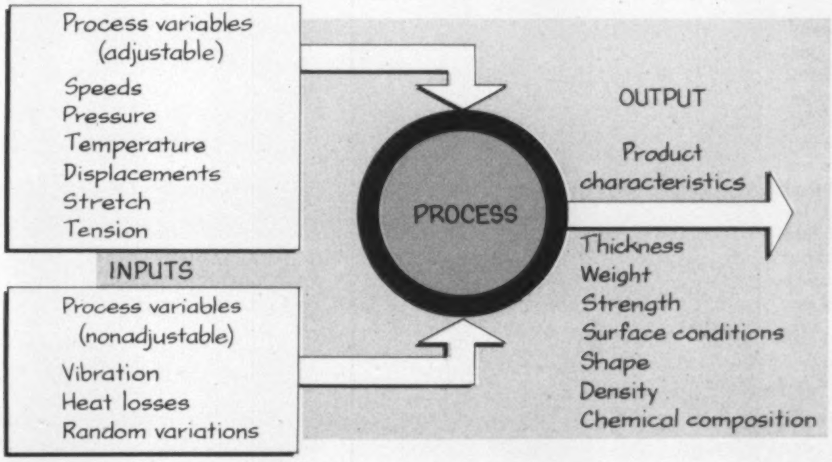
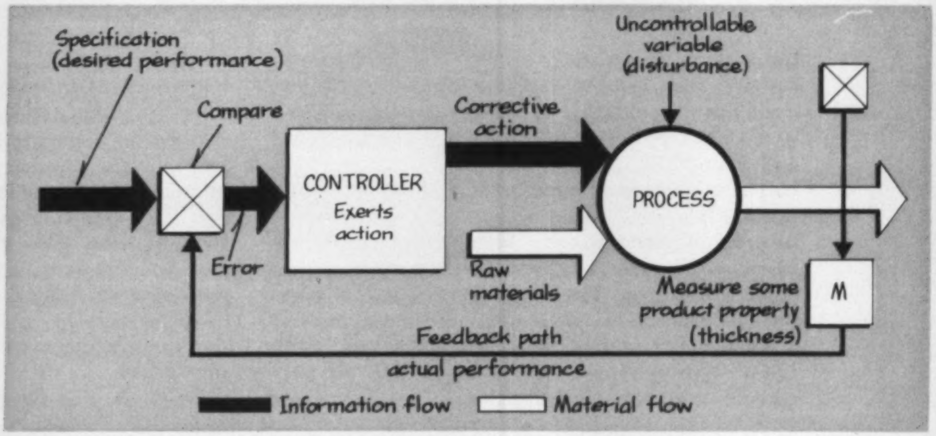


Fig. 2—Information input-output model of a manufacturing process lists the adjustable and nonadjustable input variables and the important product characteristics that need to be controlled. Although process variables and product characteristics exist in a physical sense, they cannot be controlled until a proper measurement is made of their values.

Fig. 3—Diagram illustrates a simplified feedback control system in which a single product characteristic is measured and one process variable is adjusted. In some processes, this degree of automatic control is sufficient to obtain considerable economic savings. However, many processes require the simultaneous adjustment of multiple product variables which often interact with each other to further complicate control.



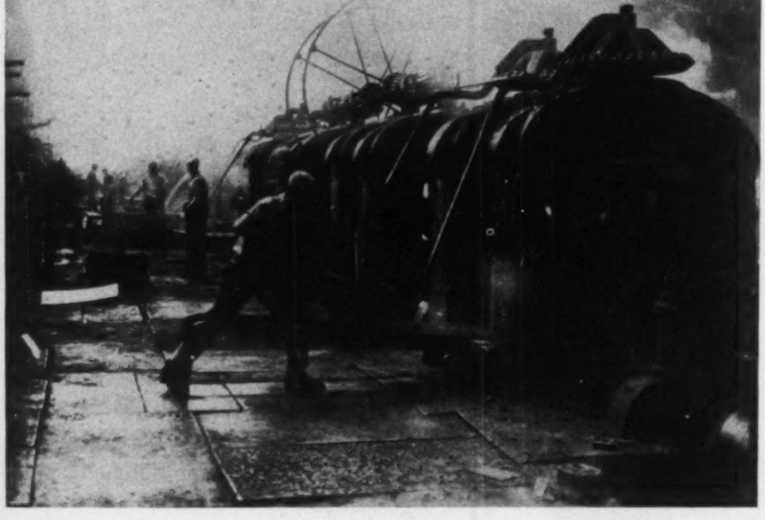
proper measurement is made of their values. Once the important process variables and product characteristics are measured, automatic or manual adjustments of the variables can be made. Therefore, the designer of a feedback control system today is faced with a system describable only in terms of multiple input-output relationships.

▶ Measurement and Control

The conventional automatic controller has operated on the basis of a measurement of an individual characteristic or variable and the resulting adjustment of another variable based upon the deviation of the measured variable from some standard. A feedback control system in which a single product characteristic is measured and a single process variable adjusted is shown in *Fig.* 3. The elements of the control system shown are: 1. A measuring device. 2. A comparator. 3. A controller. 4. The process itself. Shown in the diagram is a flow of raw materials to the process and the flow of data to properly control the process. To date, considerable economic savings have been accomplished through precise measurement of a product characteristic, such as thickness or weight, and the resulting automatic control of a single process variable.

It is well known, of course, that many industrial processes are controlled through the direct measurement and adjustment of individual process variables, such as temperature, pressure, and level. Such controls are often referred to as environmental variable controls. In such control, which is standard in the chemical and petroleum industries, the functional relationship between the input variables and the output product characteristics are assumed. The basic control philosophy is that as the process variables are maintained at proper values, the output

Fig. 4 — Historical photograph shows a manually operated steel rolling mill in which an operator furnished the means for handling the steel and adjusting the mill screwdown. Output from the mill was approximately 12 tons per day using two crews of six men each that worked alternately. Today, a continuous cold rolling tandem mill can produce about 60 tons of steel per hour using automatic control devices and approximately 12 operating and maintenance men.



product characteristics will be satisfactory. Such viewpoint, of course, involves the assumption that the functional relationships between input and output variables do not change for a given process and product. It is further assumed that extraneous factors or noise do not greatly affect the output.

In many processes, the goal is to control not only one product characteristic but to control in combination a number of the important product characteristics. To effect an optimum control of these product characteristics requires the simultaneous adjustment of multiple product variables, such as displacements, temperatures, and speeds. Considerable work in the theoretical realm is proceeding on various schemes and systems for the simultaneous adjustment of input process variables in accordance with the end product. The recent Joint Automatic Control Conference held at M.I.T. in September, 1960, presented various approaches and suggested systems for such control. It might be worthwhile to mention that in the chemical and petroleum industries, at least, the ultimate in multiple input variable control based upon the end product will be somewhat delayed until the time that suitable on-stream analyzers can be developed.

▶ Four Stages

An objection might be raised to the subdividing of an automatically controlled process according to materials, energy, and information flow. The question naturally arises: Is not the most important element of all—the human—neglected? It has been said that in the future as in the present, operations will depend upon the human because after all the world is being planned for man by man. In any model of a manufacturing process the human is always the underlying element. The only thing which varies is the degree and way in which the human participates with his muscles and his brain in the manufacturing operation. In very early processes, energy was supplied by the human's muscles in forming, shaping, or assembling the product.

Four stages of human participation in manufacturing operations may be recognized. These may be designated (somewhat colloquially) in the following manner: Stage 1—Man as the machine. Stage 2—Man in the machine. Stage 3—Man controlling the machine. Stage 4—Man as the overall master of the machine.

An example of these four rather evolutionary stages can be found in steel rolling operations. At the first stage (man as the machine) iron sheets were produced by hammering hunks of hot iron into reasonably flat sheets. Apparently crude tools were used. The man was truly the machine in the sense that he applied his own power to forming the sheet. Just when flat metal sheets were first produced is lost in history.[3]

It is believed that Stage 2 (man in the machine) occurred around the year 1700 when the Welsh were reported to be rolling steel plate by a secret process.[3] Steel was rolled back and forth through a rolling mill. Although the rolls themselves were powered by steam or water devices, the handling of the steel and the adjustments of the screw positions were accomplished by men. Great skill as well as physical endurance was required. The materials handling equipment consisted of tongs with which the mill operators manipulated the steel back and forth. The tonnage output for two crews of six men working alternately was approximately 12 tons per day, or roughly a ton per day per man.

Hand rolling of steel was practiced in this country until 40 or 50 years ago, *Fig.* 4. The work was strenuous, exhausting, and dangerous. Even so, there was some "romance" associated with it. The head roller had to apply considerable brain power as well as muscle power to controlling his process. The head roller (or mill operator) calculated the thickness at various times in the rolling operation by knowing the initial weight of the sheet bar, the length to which the sheet was to be rolled, and the width of the sheet.[3] It might be mentioned that early rolling operators were lucky to make as much as $2 or $3 per day.

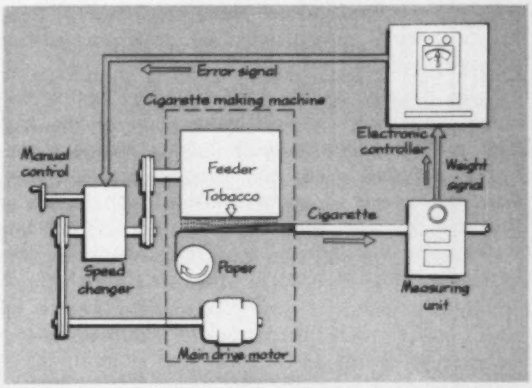


Fig. 5—Weight control system for a cigarette making machine is shown in this diagram. Plus or minus variations from the desired weight are sensed by the measuring unit and sent to the electronic controller. Error signal from controller causes speed changer to increase or decrease feed of tobacco to wrapper.

The third stage (man controlling the machine) occurred with the introduction of continuous, wide strip steel rolling mills. Tandem continuous hot and cold rolling mills came into operation in this country during the late 1920s and 1930s. These mills applied electric power to drive the steel from the first or input stand to the exit stand, and power for all screw and roll settings was supplied by electric motors. The human then pushed buttons, turned rheostats, and adjusted valves to maintain a good output product based upon the best data he could obtain on the product and process.

With the advent of continuous rolling mills, productivity jumped tremendously. For example, a modern-day, cold rolling tandem mill can produce approximately 60 tons an hour or a ton of steel per minute. Therefore, a modern continuous tandem cold rolling mill will produce as much steel in 12 minutes as was previously produced by 12 men working a 10-hour shift. The total number of men required to operate and maintain the mill is roughly the same, especially if one considers the millrights, crane operators, and technicians that operate and maintain the various mechanical and electrical devices associated with modern-day, automatically controlled tandem mills. Productivity and output per man took a jump of almost 5000 per cent when motors and machines were substituted for muscle. Those anticipating the explosive effects of more sophisticated automation and computer controls will be hard pressed to produce such a jump in incremental productivity, at least on existing processes.

Stage 4 (man as the over-all master of the machine) involving the full automation of the tandem milling operation will include computer-controllers, multiple gages, and elaborate materials handling equipment to maintain sheet steel flowing to the mill all the time. Combination control-data systems for the tandem cold rolling process have been described, at least in part, elsewhere.[4, 5, 6] In spite of the degree of sophistication and complexity of the required control-data system, productivity would be increased only 25 to 35 per cent over what is now being accomplished on high-speed rolling mills. A principle which is often overlooked today by some of the more vocal prophets of automation doom is that many of the greatest jumps in productivity occurred when machines were substituted for man's muscles. The 35 per cent increase in productivity is a far cry from the jump of 5000 per cent brought about by the continuous rolling mill replacing the hand-operated mill.

Combined Control-Data Systems

In complex manufacturing operations, multiple machines or processing stages often exist. In some processes, machines bear a tandem relationship to one another; that is, the materials or semifinished products are fed progressively from one machine to another. The cold rolling of steel with its sequential tin plating is an example of a tandem process. Other manufacturing operations involve multiple machines in parallel, each of which manufactures a similar product. Individual products are then conveyed or transported from each machine, brought together, then packaged and shipped. Industries in which parallel machines are used to a large extent are those manufacturing plastic film, paper materials, and tobacco products.

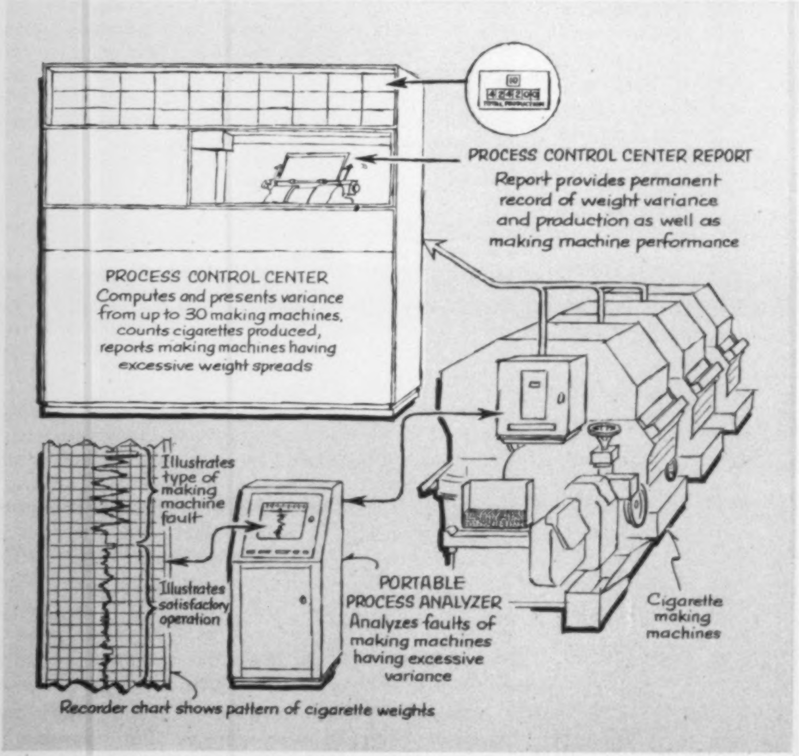

10
TOTAL PRODUCTION
PROCESS CONTROL CENTER REPORT
Report provides permanent record of weight variance and production as well as making machine performance
PROCESS CONTROL CENTER
Computes and presents variance from up to 30 making machines, counts cigarettes produced, reports making machines having excessive weight spreads
Illustrates type of making machine fault
Illustrates satisfactory operation
PORTABLE PROCESS ANALYZER
Analyzes faults of making machines having excessive variance
Cigarette making machines
Recorder chart shows pattern of cigarette weights

Fig. 6—Automatic system for collecting, analyzing, and tabulating weight variation and output data from 30 cigarette making machines is shown. Electronic controllers on each machine maintain desired cigarette weight as diagrammed in *Fig.* 5. In addition, these controllers send data signals to the process control center for tabulation of individual machine performances. Portable process analyzer can be used to record pattern of cigarette weights produced at any machine having excessive variance.

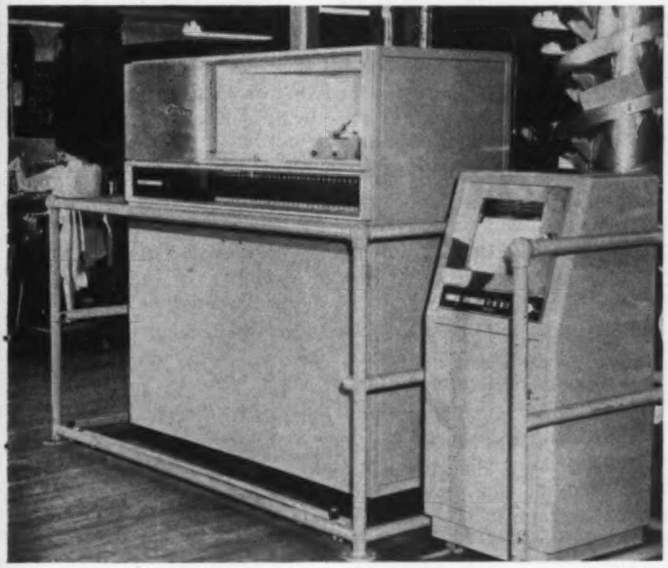


Fig. 7—This view shows close-up of a production control center and portable process analyzer for handling data from 30 cigarette making machines.

In the cigarette industry, multiple but similar machines produce cigarettes. Prior to about 1954, individual cigarette making machines were allowed to run free. Periodically, samples from each machine were taken and weighed. Individual adjustments were then made to each machine by a machine operator. By a sampling process of machine control only a very small percentage of the total output unit products could be checked. For example, in a factory with 500 cigarette making machines there would be produced about 250 million cigarettes daily. On an annual basis this number would be about 65 billion cigarettes. Fifty quality control personnel could at best weigh and inspect less than one per cent of a total day's production.

In early 1955, gage-controllers were developed which measured the weight of cigarettes produced and automatically adjusted the average tobacco feed. *Fig.* 5 illustrates a simplified diagram of a cigarette machine under automatic control. With control based upon 100 per cent sampling, the variation in weights of cigarettes was greatly—even drastically—improved.

A computer-data system which is now in operation for gathering, computing, reorganizing, and tabulating quality and production data is shown in *Fig.* 6. In this manufacturing process, there are individual gage-controllers installed on each processing machine. The presently existing gages on the machines measure individual weights plus the total number of units produced per period of time. This data from 30 machines is communicated to a production control center, *Fig.* 7.

At the production control center statistical computations are made. Statistical parameters are, therefore, obtained on average weight and individual product variance. A record is typed out at the production control center of the variance of product quality from each machine. In addition, the production outputs per unit of time are also read out at the production center.

It has been our experience in many processes that automation is an evolutionary thing. First, individual machines are automatically controlled based upon measurements of their end product. Since the control of each machine requires various measurements, a large amount of data is generated. This data can then be logically transmitted to a central data station. At the central data station the data can be reorganized and proper computations made on it to yield information on production rates, quality, and costs. In many operations the quality information or product variance finds valuable use as a guide to machine maintenance and overhaul. When such reduced data is utilized by maintenance personnel to keep machines in best mechanical condition, a higher order control loop is set up in which the human is a participating control element.

The next step now being developed as an extension of the production data system will expand the data system into an automatic cost control sysem. In this system, information on quality and production rates for each machine is obtained. At each individual machine it is now possible, through the use of high-speed gages, to sense and divert rejected products. An automatic count can be made of the number of rejects. The count of rejected products can then be communicated to a data center and the total salable production obtained by subtracting the rejected production from the total number of units produced. Since the gage-controller on each machine measures the mass "that it sees," it is possible to integrate over a production period —for example, a day—the total weight of raw materials used per machine. The current cost per pound of raw material can be fed into the data system so that there is computed at the end of each day a materials cost figure for each machine.

In addition to material costs, the actual number of labor hours can be automatically tabulated and overhead figures fed into the production-cost center. With the available information obtained from gages on individual machines plus other slower-varying accounting data, the cost per product produced can be determined at the end of each day. Individual product costs by machine can be temporarily stored. By regrouping of data, it then becomes a simple matter to tabulate the total cost per item, per brand, or per package of each product produced. Further, a communications network which links together various factories in a given company would provide the company headquarters with daily information on manufacturing and operating costs of various factories. At the company headquarters, marketing and administrative costs could be applied to compute the daily profit figure. "On-the-spot" automatic machine control plus data processing obtained directly from factory machines can increase

THE AUTHOR

HENRY R. CHOPE graduated from Ohio State University with a BS degree in Electrical Engineering. He also holds advanced degrees from the California Institute of Technology and Harvard University. During World War II, he developed and applied microwave devices for meteorological measurements. After the war, Mr. Chope was employed by the Cambridge Research Laboratories as an electronic scientist engaged in rocket research. In 1950, he was a cofounder of Industrial Nucleonics Corp. where he is now executive vice president. In this position, he has developed gages and automatic controls for industrial processes including those in the rubber, plastics, paper, and tobacco industries.

the over-all operating efficiencies of a given manufacturing operation and, in turn, yield higher profits.

▶ Future Goal

The approach to automated manufacturing is essentially a step-by-step procedure starting at the machine which produces the basic product that the manufacturer must sell at a profit.

Integrated automation systems which tie together manufacturing, quality control, accounting, and management are, by and large, still for the future. Emphasis in such over-all systems is on the quality and cost of the product itself and on the machines which produce the product. The dividing lines between the various classical business functions, such as manufacturing, quality control, and accounting, tend to disappear and in turn to merge into one over-all discipline. The goal of this unified function then becomes that of obtaining meaningful data, organizing the data, comparing the data to certain specifications, and then finally acting upon the data with minimum time lag. The action taken on the data may be automatic (as it is today at the lower control levels) or manual.

Any system, whether it is for measurement, control, or data, must over the long run be justified on an economic basis. That is, the cost of installing and operating the system must be offset by the quality and profit advantages to be gained from the system. Automation systems, properly analyzed and selected, can play a major part in improving productivity, upgrading quality, and lowering costs. Such systems are necessary if we in this country are to continue to be competitive with the rest of the world and to increase our over-all standard of living during the several decades ahead.

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are you stuck?

Since its inception AUTOMATION has helped increasingly in the solution of hundreds of widely diversified practical problems in making manufacturing operations more automatic. Regardless of the character of the operation or system being developed, somewhere in industry a similar problem has been solved and, very often, equipment is available from reliable builders or suitable techniques are known to specialists.

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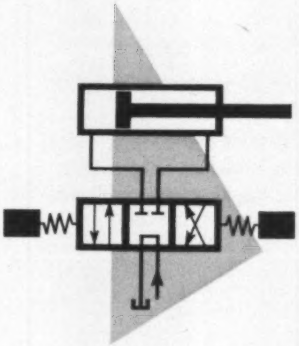


Part 2

MULTI-ACTUATOR SYSTEM CONSIDERATIONS

INDUSTRIAL HYDRAULIC CIRCUITS

This second part of a four-part series on industrial hydraulic circuits deals with arrangements for sequencing and interlocking several actuators operating from a single hydraulic power source. Discussion includes considerations applying to the use of single or multiple actuators where gravity effects are important. Also covered are factors in choosing pumps and unloading arrangements.

By **JACQUES CARPENTER**, Industrial Products Dept., Vickers Inc., Detroit. Mich.

MACHINE systems with virtually any number of actuators may easily be built up from a series of single actuator circuits. Although such a course would provide a system that has maximum versatility, because of independent control of fluid volume and pressure for each actuator, it would often be impractical from a space and cost standpoint. For example, on a machine that has several actuators, it would be necessary to provide an equal number of electric motors and controls, pumps, etc.

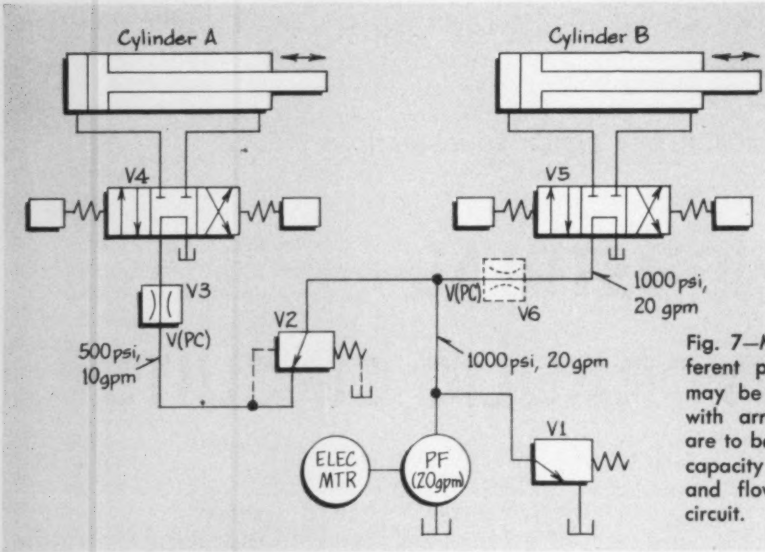
An alternative arrangement is to operate more than one actuator from a single pumping source. New problems are then introduced, however, because each actuator may be in competition for the output of a single source of pressure and volume. Usually, the pressure and flow requirements will be different for each actuator in the system.

A common method of regulating flow and pressure in multiple actuator circuits is diagrammed in *Fig.* 7. The flow figures shown in the illustration assume that the cylinders do not move simultaneously. If it is necessary that they move together, then the pump capacity must be increased to supply the sum of individual cylinder flow requirements, and some means of dividing the flow must be included in the circuit. The latter action may be accomplished by addition of flow control valve *V*6 shown in broken lines.

Sequencing Multiple Cylinders

When a machine system uses two or more cylinders, usually they must be sequenced or interlocked with respect to one another. The simplest way of sequencing two cylinders is to insert a restriction valve in the pressure line to the second unit, *Fig.* 8. Since fluid flow will tend to take the path of least resistance, most of the initial flow will go to cylinder *A* and cause the piston of this unit to advance. Some oil will flow to cylinder *B* through the restriction valve, however, so that there will be an overlap of traverse motion between the two cylinders.

If this condition of motion overlap is undesirable, a sequence valve can be substituted for the restriction valve, *Fig.* 9. The spring setting of the sequence valve is adjusted to a pressure greater than that required to move cylinder *A*. Then, all of the fluid will go to cylinder *A* until the end of the piston advance stroke is reached or a positive stop is en-



KEY TO CONTROL VALVES

V1 - Relief valve (set at 1000 psi)
V2 - Pressure reducing valve (set at 500 psi)
V3 - Flow control valve (set for 10 gpm)
V4,V5 - Directional control valves
V6 - Flow control valve (optional, set for 20 gpm)

Fig. 7—Multiple actuators that have different pressure and flow requirements may be operated from a single pump with arrangement shown. If cylinders are to be operated simultaneously, pump capacity should be increased to 30 gpm and flow control valve V6 added to circuit.

countered. When advance motion of cylinder *A* is stopped in such a manner, oil pressure builds up sufficiently to open the sequence valve and permit flow to cylinder *B*.

If there is danger that cylinder *A* might jam or bind, thus sequencing oil to cylinder *B* prematurely, then a position sensing pilot valve can be added to the circuit, *Fig.* 10. With this arrangement, cylinder *A* must attain the desired advance position before the sequence valve opens to admit oil to cylinder *B*. A solenoid pilot valve can replace mechanically operated pilot valve *V*3 if electrical interlock action is preferred. This valve can be actuated by a limit switch closed by the rod cam when the piston of cylinder *A* is advanced.

A common misconception concerning sequence valves is that line pressure necessarily drops off when such components are series connected. While this is true in the case of "unbalanced" sequence valves, it is not true when "balanced" pilot sequence valves are used. Any number of balanced type valves can be connected in series without increasing the pressure needed at the pump to maintain adequate pressure at all of the cylinders in line.

Constructional features of balanced and unbalanced sequence valves are illustrated in *Fig.* 11. Also shown are typical three-cylinder sequencing circuits using each type of valve. Note from the cut-away diagram, *Fig.* 11*a*, that any pressure developed downstream of the unbalanced sequence valve will act on top of the poppet. The force developed by this action will add to the valve spring setting. In the accompanying circuit using such valves, a pump pressure of 1300 psi (300 + 400 + 600 psi) is required to ensure availability of 600 psi in the last cylinder. If, say, only 1000 psi pump pressure were available, then only 300 psi (1000 − 300 − 400 psi) would be available at cylinder *C*. This pressure would be inadequate if 600 psi were required to move the cylinder against a load.

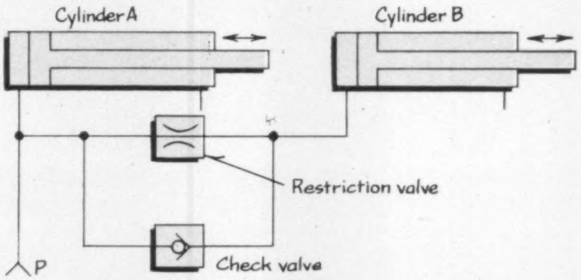


Fig. 8—Sequencing of two cylinders may be accomplished by placing a restriction valve in the pressure line to the second unit. Disadvantage of this circuit is that some overlap of traverse motion will occur and timing between cylinders is susceptible to variation due to changes in load, oil temperature, etc. Function of check valve in circuit is to facilitate rapid return of cylinder B.

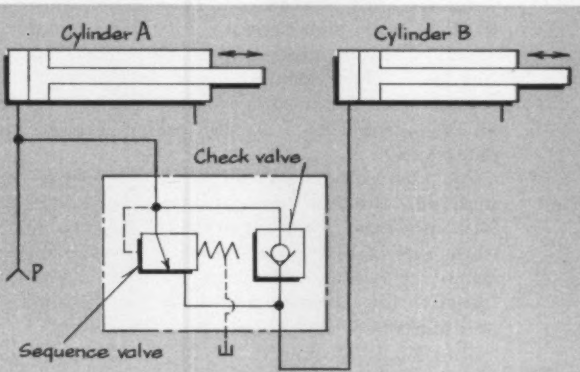


Fig. 9—Use of a sequence valve in circuit ensures "stepped" operation of two cylinders. System is relatively unaffected by changes in oil temperature or load except when load exceeds the setting of the sequence valve.

In the balanced sequence valve design, *Fig. 11b*, downstream pressure does not affect the valve spring setting and, thus, such pressures are not additive. The pump pressure required in this case is only the 600 psi required by cylinder *C*. In the circuit for balanced sequence valves, *V5* and *V6* will be opened fully since the working pressure developed at cylinder *C* is considerably higher than the spring settings of the sequence valves.

Frequently, it is necessary to maintain pressure on one cylinder in the return direction until a second cylinder has advanced. In this case, sequencing can be accomplished by using a four-connection directional control valve for each cylinder, *Fig.* 12.

The hydraulic circuit for a tube forming machine, *Fig.* 13, illustrates the combining of sequence controls to effect phased operation of multiple cylinders. A combination of hydraulic and electrically operated controls is used.

At the start of a cycle, the clamping and forming cylinders are in their retracted positions and a locating cylinder is advanced. An operator inserts a tube between a pair of clamping jaws with the leading edge of the tube against a stop positioned by the locating cylinder. To start a cycle, the righthand solenoid of valve *V1* is energized and the spool shifts to a position admitting fluid to the righthand pilot of valve *V2*. The spool of this valve shifts and admits fluid to the clamping and locating cylinders. The lefthand pilot of *V2* is connected to tank through *V4* and *V1*. The clamping cylinder closes the clamping jaws and the locating cylinder retracts. Restriction valve *V3* provides a delay so that the workpiece will be clamped before the locating stop is retracted.

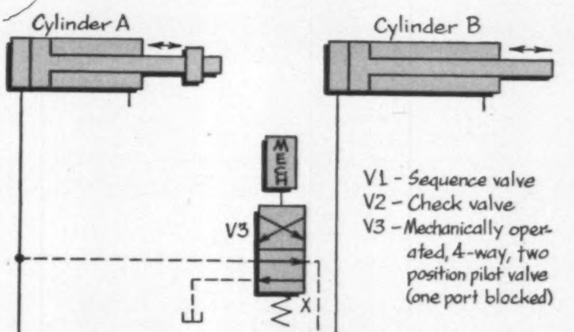

Cylinder A
Cylinder B
MECH
V3
V1 - Sequence valve
V2 - Check valve
V3 - Mechanically operated, 4-way, two position pilot valve (one port blocked)
X
P
V1
V2

Fig. 10—Position sensing pilot valve *V3* in this circuit provides safety feature to prevent operation of sequence valve *V1* until cylinder *A* reaches its fully advanced position. Thus, if cylinder *A* jams or binds during its outstroke, pressure built up will not open *V1* and cylinder *B* will not advance.

Sequence valve *V5* next opens and admits fluid to the blind end of the forming cylinder. The piston of this cylinder advances to form the end of the tube. Forming speed is determined by the setting of flow control valve *V6*.

When forming has been completed, pressure in the blind end of the forming cylinder increases. When this pressure equals or exceeds the setting of pressure switch *PR SW*, contacts in the latter unit will close and actuate the lefthand solenoid of valve *V1*, and the spool will shift. The forming cylinder will retract because pressure is applied to its rod end with its blind end connected to tank through *V7* and *V1*.

The clamping cylinder remains advanced, and the locating cylinder remains retracted, until the end of the return stroke of the forming cylinder when valve *V4* is depressed by a cam on the forming die. This action admits pressure through *V1* and *V4* to the lefthand pilot of valve *V2* and the spool of this valve shifts. The clamping cylinder then retracts and the locating cylinder advances to complete the machine cycle.

A simple method that can be used to sequence several motions is shown in *Fig.* 14. This circuit is used on an automobile muffler assembly machine. To program a machine cycle, several adjustable cams are mounted on a common shaft which is driven by a small electric motor through a gear reducer. Each cam operates a limit switch that actuates the solenoid of a hydraulic control valve. The phase relations and shapes of the cams determine the sequence of operations.

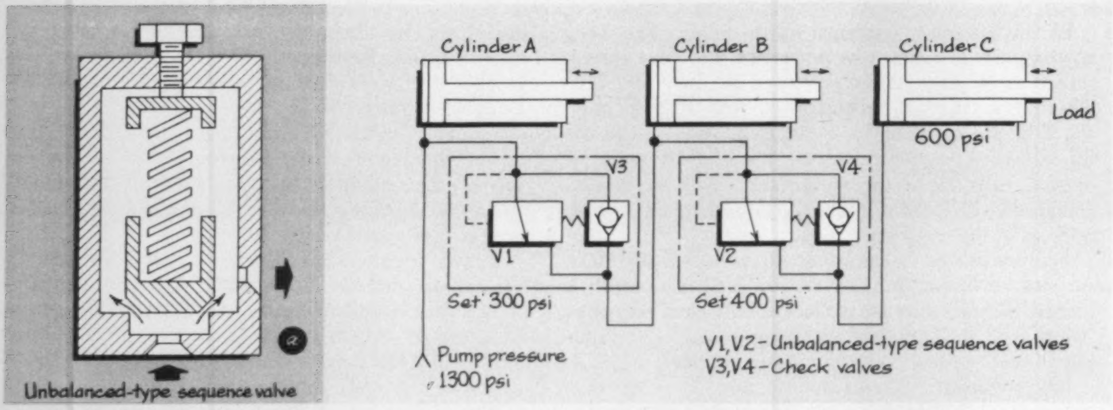
Occasionally, electrical controls must be omitted from automatic sequencing circuits as when the equipment must be operated in explosive environments. In such cases, interlocking may be accomplished with purely mechanical and hydraulic elements.

▶ Sequencing Fluid Motors

Where rotary rather than linear motion is required, fluid motors can be substituted for cylinders in most of the sequencing circuits described previously. Fluid motors are particularly adaptable to rotary indexing table drives.

The arrangement of *Fig.* 15 uses a simple but effective indexing circuit that includes a fixed displacement fluid motor *MF*. In the indexed position the fluid motor is attempting to rotate the table but is prevented from doing so by a pawl and locating pin. To index the table, the fluid motor is reversed by four-connection directional control valve *V1*. This causes the table to rotate until a cam carried by the table operates limit switch *LS1*. At this time, the pawl has slipped over and moved slightly beyond the next locating pin.

Operation of *LS1* by the table causes the spool


Cylinder A
Cylinder B
Cylinder C
Load
600 psi
V3
V4
V1
V2
Set 300 psi
Set 400 psi
Pump pressure
1300 psi
V1,V2 - Unbalanced-type sequence valves
V3,V4 - Check valves
a
Unbalanced-type sequence valve

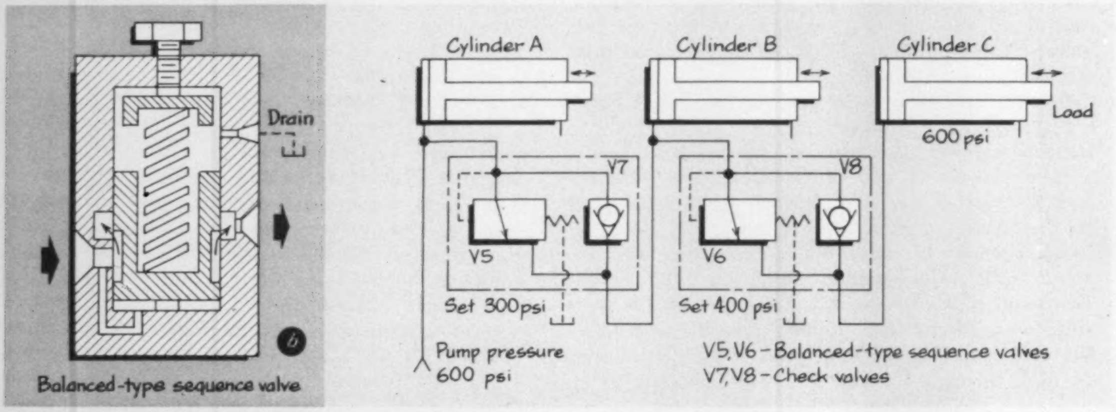

Drain
Cylinder A
Cylinder B
Cylinder C
Load
600 psi
V7
V8
V5
V6
Set 300 psi
Set 400 psi
Pump pressure
600 psi
V5, V6 - Balanced-type sequence valves
V7, V8 - Check valves
b
Balanced-type sequence valve

Fig. 11—Two types of sequence valve are *(a)*, unbalanced, and *(b)*, balanced. With balanced type, pressure at outlet port does not add to spring setting of valve. Comparison of multiple cylinder sequencing circuits using each type of valve shows lower pump pressure requirement to produce same pressure at last cylinder in line when balanced type valves are used.

of *V*1 to shift and reverse the fluid motor. The table then backs up until the pawl rests against the locating pin that was passed. This completes one index motion of the table.

Restriction valve *V*2 reduces the speed of the fluid motor during back-up of the table so that the pawl does not come against a locating pin too fast. A flow control valve, *V*3, establishes the speed of the table during indexing. Additional cams on the table (not shown) actuate clamp cylinder valves *V*4 and *V*5 at the proper times so that fixtures mounted on the table will be unclamped when they are indexed to a load/unload position.

Another common type of table indexing circuit is shown in *Fig.* 16. In this arrangement, indexing begins when a locating pin is withdrawn from the table by operation of the righthand solenoid of valve *V*1 controlling a locating pin cylinder. The table is then rotated at full system pressure of 600 psi controlled by relief valve *V*3. The outlet port of relief valve *V*4 is open to tank at this time because its vent connection is drained to tank through *V*2.

When limit switch *LS*1 is contacted by a cam on the index table, the solenoid of valve *V*2 is en-

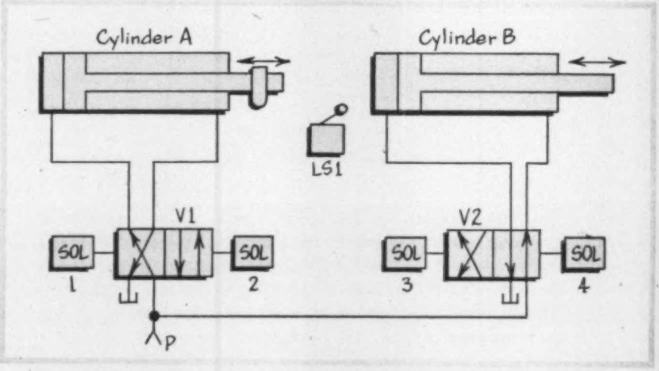

Cylinder A
Cylinder B
LS1
V1
V2
SOL
1
SOL
2
SOL
3
SOL
4
P

Fig. 12—Use of separate four-connection directional control valve for each cylinder in a circuit provides versatile sequencing control. In circuit shown, pressure is maintained on the rod end of cylinder *B* to keep its piston retracted until cylinder *A* has advanced fully and actuated limit switch *LS*1 to energize *SOL*3.

ergized and the valve spool shifts. This blocks the vent path to tank for *V*4 and opens a path to tank for the outlet connection of relief valve *V*5 set for 200 psi. This has the effect of reducing the pressure available at the fluid motor, and the speed of this component decreases under the control of restriction valve *V*6. With the lefthand solenoid of valve *V*1 energized, the locating pin will bear against the table as the table rotates slowly to the next index position. Indexing is completed when the locating pin moves into position.

The index table drive system shown in *Fig.* 17 is particularly suited for applications involving fast table speeds and high table inertias. In operation, the lefthand solenoid of valve *V*1 is energized to cause retraction of the locating pin. As the locating pin retracts, a cam releases *LS*1 and the solenoid of valve *V*2 is energized. The spool of this valve shifts and admits pressure to fluid motor *MF*. The table then rotates rapidly until a cam carried by the table depresses deceleration valve *V*3 causing slowing of the table.

When further motion of the table causes the cam to actuate *LS*2, the righthand solenoid of *V*1 is energized and the locating pin extends against the table. Full extension of the locating pin cylinder later causes the cam on the piston rod to operate *LS*1 and de-energize the solenoid of valve *V*2. This stops the fluid motor until the next index cycle is initiated.

▸ Special Considerations

Frequently, in both single and multiple actuator systems, a cylinder is called upon to move a mass up and down or at an angle from the horizontal. If the machine construction does not include a coun-

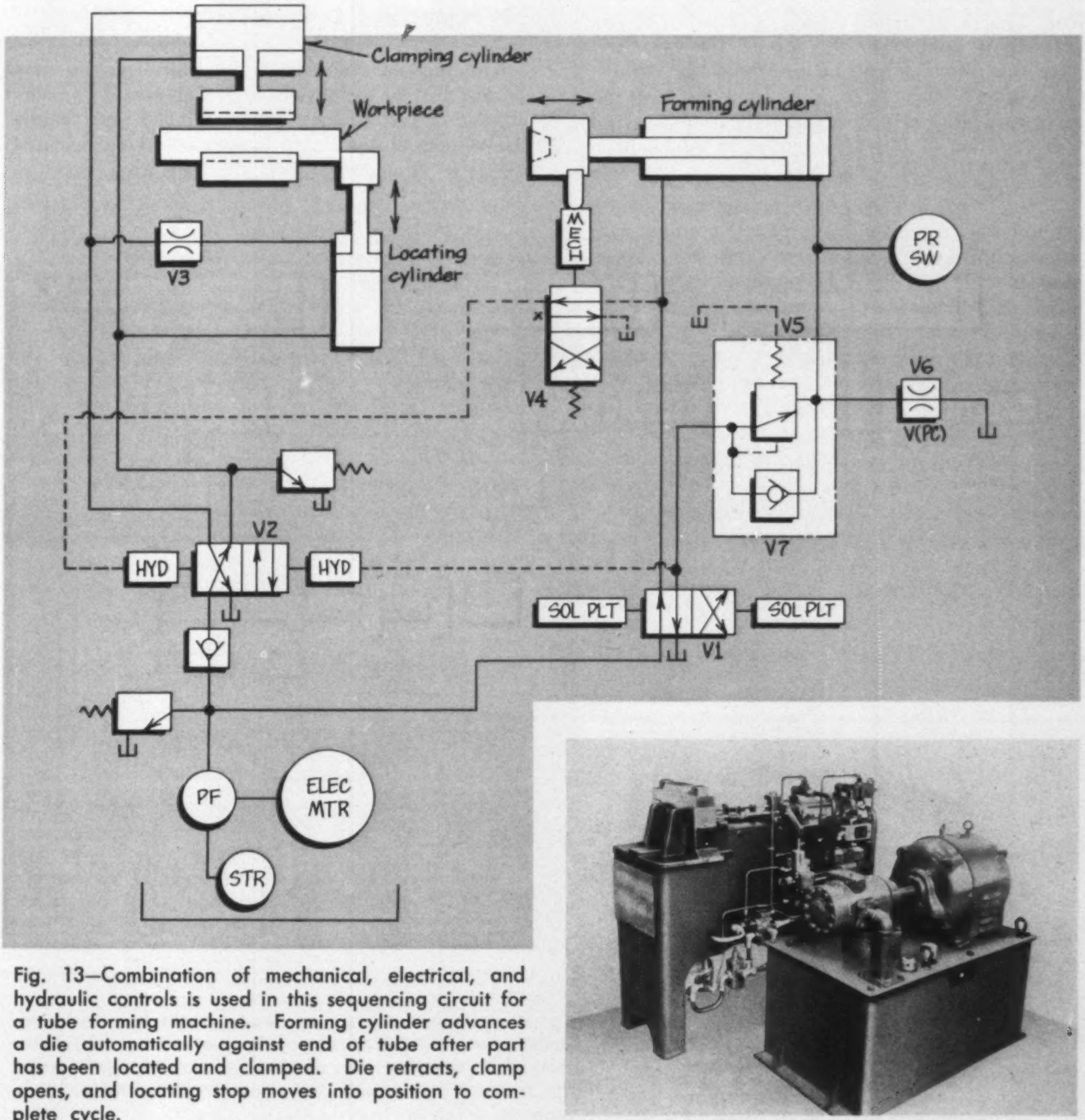


Fig. 13—Combination of mechanical, electrical, and hydraulic controls is used in this sequencing circuit for a tube forming machine. Forming cylinder advances a die automatically against end of tube after part has been located and clamped. Die retracts, clamp opens, and locating stop moves into position to complete cycle.

Courtesy, Vaill Engineering Co.

terweight to balance the gravity load, some means of hydraulic counterbalancing against the pull of gravity may be required.

A check valve in the pressure supply line to a directional control valve, *Fig.* 18*a*, will prevent a load from falling due to loss of supply pressure during an upstroke. To prevent the load from dropping too quickly during a downstroke, an orifice, needle valve, or flow control valve can be added to the circuit, *Fig.* 18*b*. A check valve bypasses the restricting element to permit free flow of oil to the cylinder during a piston upstroke.

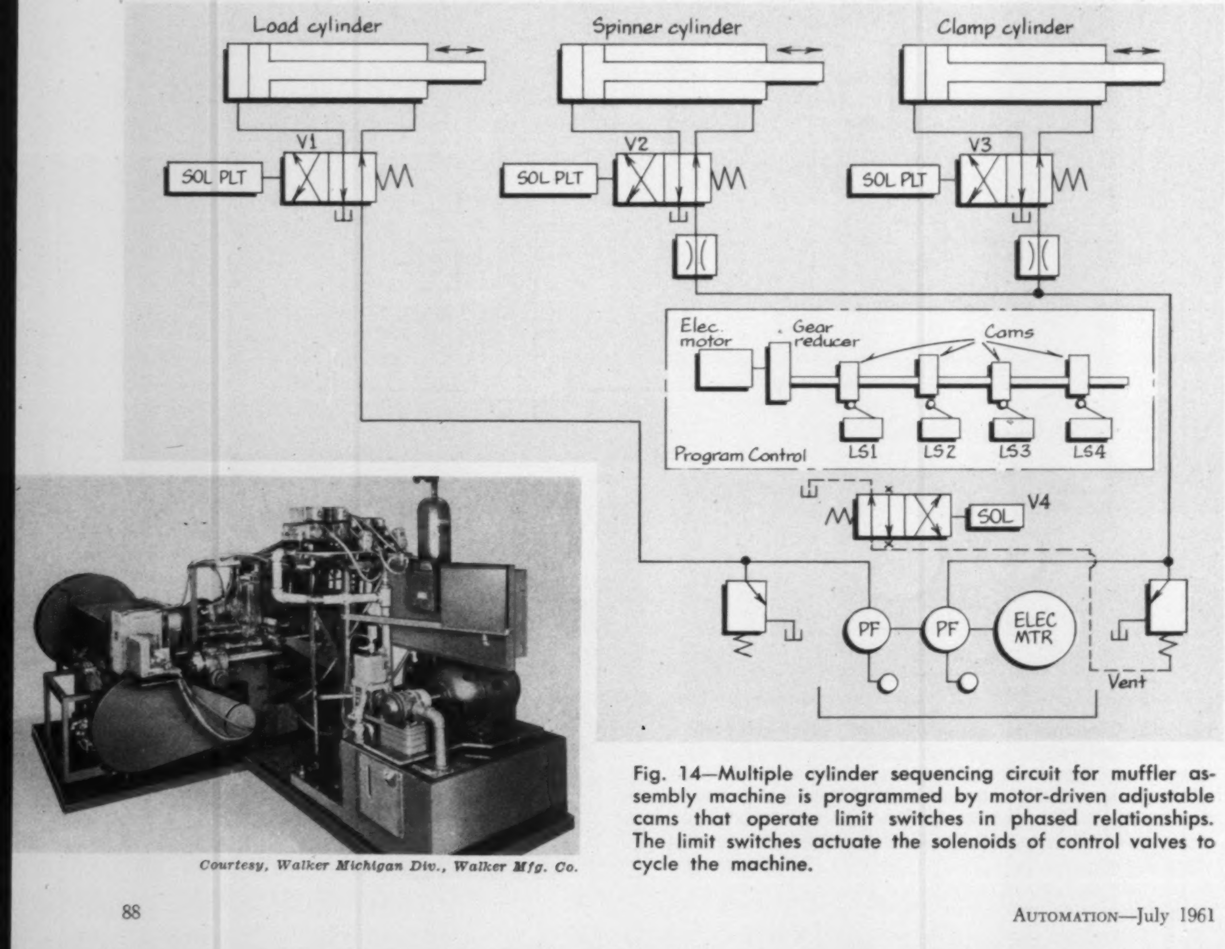
Another means of hydraulically supporting a load is to place a pilot-operated counterbalance or relief valve in the line as shown in *Fig.* 18*c*. The counterbalance valve is adjusted to a pressure setting which is in excess of that developed by the load. The valve therefore remains closed until pump pressure is applied to the top of the cylinder to force the piston down and overcome the setting of the counterbalance valve. The piston will then move downward at a rate determined by pump delivery.

A variation of this arrangement is shown in *Fig.* 18*d*. In this circuit, the pilot cylinder that opens the counterbalance valve against its spring setting is connected to a line running to the top of the cylinder. Thus, only pump pressure applied to the top end of the cylinder can open the counterbalance valve and permit lowering of the load. This feature is advantageous when the load is variable and at times may exceed the spring setting of the counterbalance valve.

The function of a counterbalance valve is to prevent uncontrolled dropping of a load, that is, dropping at a rate faster than that dictated by the amount of fluid supplied to the upper chamber of the cylinder. A counterbalance valve is not intended to hold a load in one position for an indefinite period of time. Where this is necessary, a pilot operated check valve that seals tightly against leakage is also needed, *Fig.* 18*e*. The counterbalance valve in this circuit ensures that the pilot operated check valve will remain open during downward motion of the load.

Pumps and Controls

The type of pump for a hydraulic system must be matched to the system with due regard to overall circuit performance, efficiency, and cost. While the volume of the pump is determined by machine speed requirements (once the operating pressure



Courtesy, Walker Michigan Div., Walker Mfg. Co.

Fig. 14—Multiple cylinder sequencing circuit for muffler assembly machine is programmed by motor-driven adjustable cams that operate limit switches in phased relationships. The limit switches actuate the solenoids of control valves to cycle the machine.

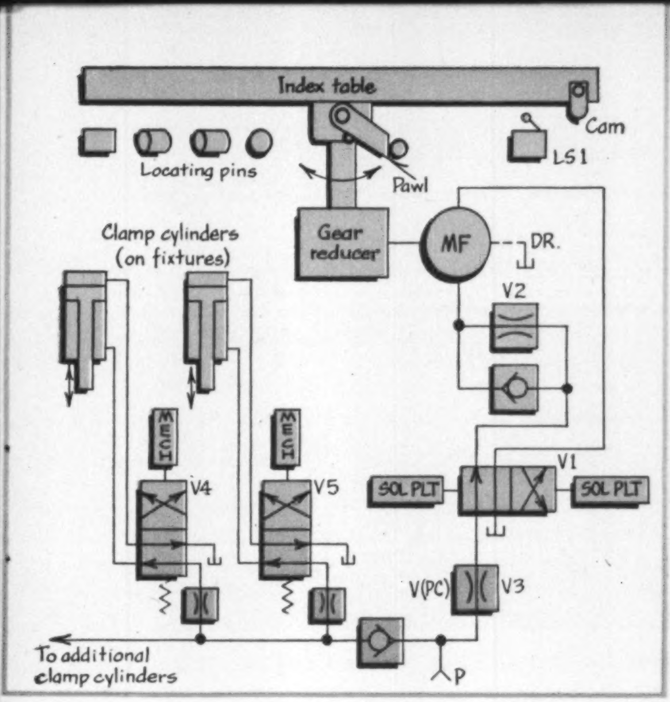


Fig. 15—Sequencing circuit for rotary index table illustrates use of a fixed displacement motor to supply table movement. Clamp cylinders are retracted automatically when fixtures carried by table are indexed to load-unload position.

has been established), the pump type is selected generally with the following in mind: 1. Maximum pressure required. 2. Duration of pressure application (pressure cycle). 3. Total system cost versus efficiency.

Fixed delivery vane, gear, and lobe type pumps are generally suitable for maximum pressures from 1000 to 2000 psi. Some models are capable of continuous operation at these pressures. Variable volume vane pumps are usually limited to operation at 1000 psi or lower. Both fixed and variable delivery piston pumps can operate continuously at pressures as high as 5000 psi. In general, variable delivery pumps of relatively complex design are more expensive than fixed delivery pumps of comparable capacities, and piston pumps cost more than vane, gear, or lobe pumps with similar outputs.

After a pump type has been selected on the basis of system pressure requirements, the over-all circuit must be analyzed to determine whether fixed delivery, variable delivery, or combination flow action is required. Several pump and pump unloading arrangements for various system requirements are shown in *Fig.* 19.

Use of a fixed delivery pump with a four-connection, three-position directional control valve is illustrated in *Fig.* 19*a*. When the valve is in the center, or neutral, position pressure is vented to tank. An alternate arrangement, *Fig.* 19*b*, uses a venting type relief valve so that the directional control valve can be a two-position type. Both of these circuits permit unloading the pump when actuator motion or thrust is not required. The advantages of pump unloading include longer pump life, less wasted power, less heat, and ability to use a lower cost pump than would be required if the pump were loaded continuously.

Such pump unloading arrangements may not be practical, however, when the machine requirements call for continuous pressure at low volume and intermittent high volume. The complication here is that the size of a fixed delivery pump to supply the intermittent, high volume flow requirements may be so large that the resulting inefficiency during the pressure holding portion of the cycle would require oversize electric motors, oil coolers, etc., if the pump were not unloaded.

The circuits of *Fig.* 19*c*, *d*, and *e* provide solutions to this problem. In *Fig.* 19*c*, an accumulator maintains system pressure (with varying flow) between the "cut-in" and "cut-out" settings of a pilot operated unloading valve. Usually, this represents

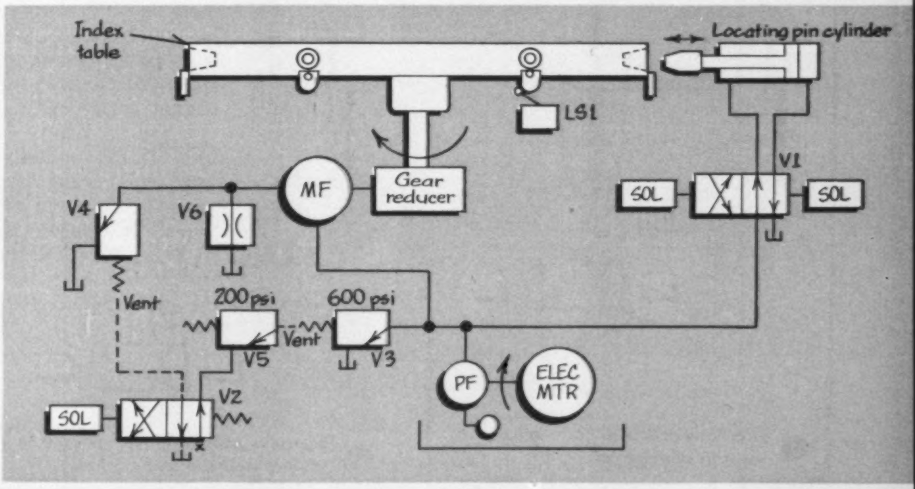
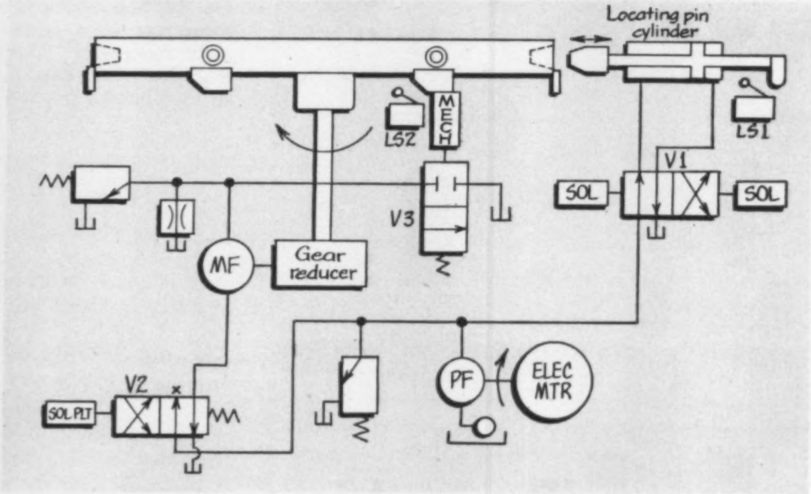
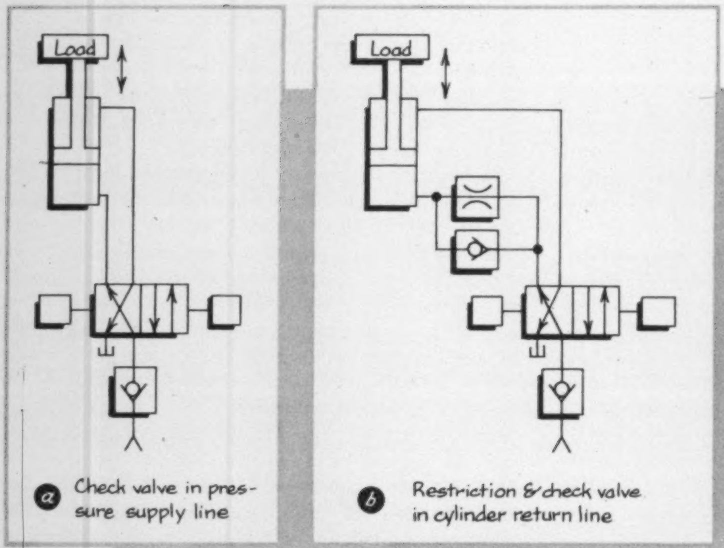


Fig. 16—Dual pressure sequencing circuit provides rapid initial indexing motion followed by relatively slow final approach to next position. Table is held in work position by locating pin during each dwell period.

Fig. 17—Index tables with relatively high inertia can be indexed rapidly with this drive system. Deceleration valve V3 is operated by a cam on the table to reduce table speed smoothly just before indexing motion is completed and the locating pin locks the table.

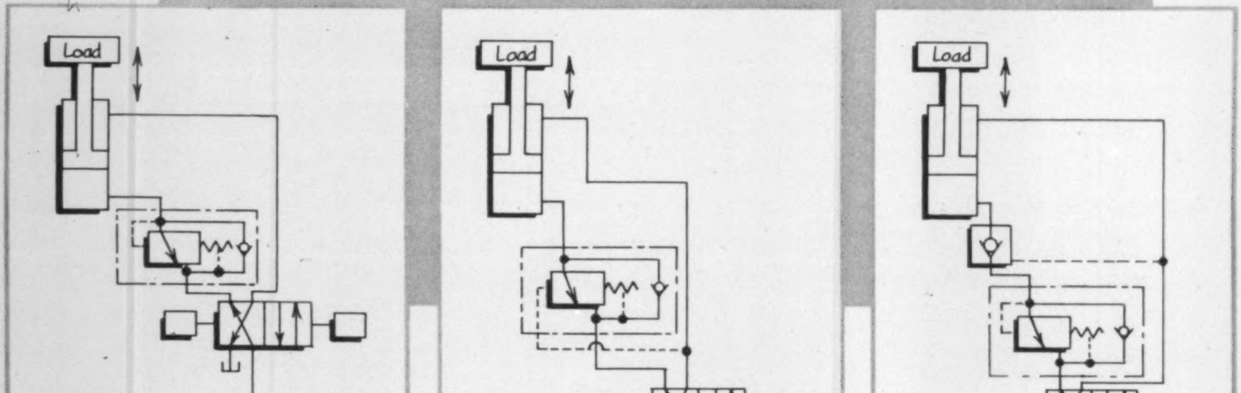

Locating pin cylinder
LS2
MECH
LS1
V1
SOL
SOL
V3
MF
Gear reducer
V2
SOL PLT
PF
ELEC MTR



ⓐ Check valve in pressure supply line

ⓑ Restriction & check valve in cylinder return line

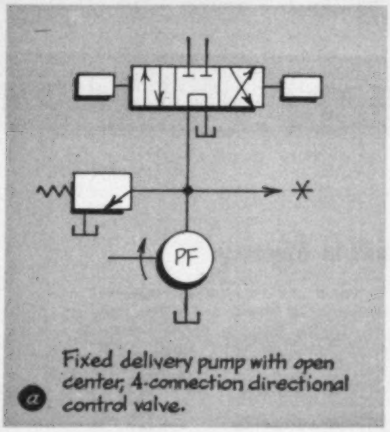
Fig. 18 — Diagrams illustrate various methods of controlling or counterbalancing vertical loads against the force of gravity.


Load
Load
Load

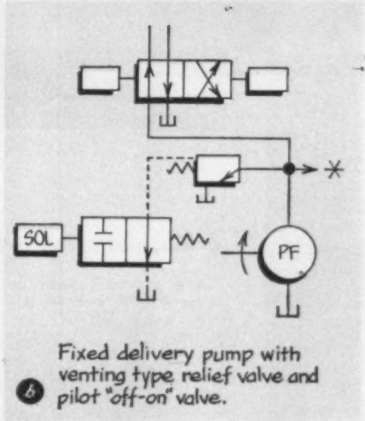
ⓒ Internally operated counterbalance valve in cylinder return line

ⓓ Externally controlled counterbalance valve in cylinder return line

ⓔ Pilot operated check valve & counterbalance valve in cylinder return line

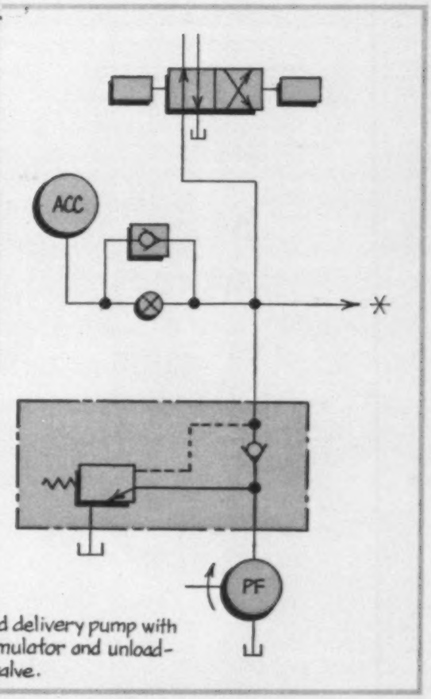


a Fixed delivery pump with open center; 4-connection directional control valve.



b Fixed delivery pump with venting type relief valve and pilot "off-on" valve.

Fig. 19—Several types of pump and unloading arrangements have been devised to meet varying pressure-volume requirements during machine cycles.



c Fixed delivery pump with accumulator and unloading valve.

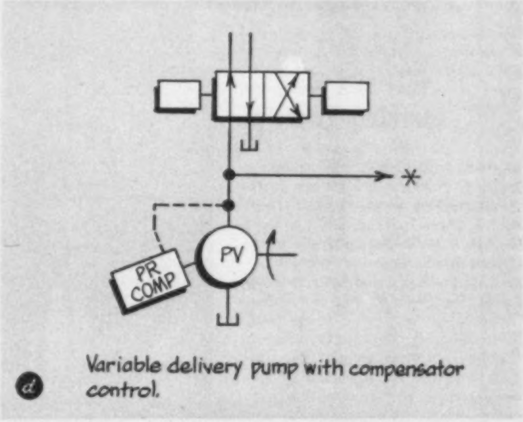
about a 10 to 20 per cent pressure variation. In operation, pump fluid will pass through the integral check in the unloading valve during high volume, low pressure periods. When pressure builds up, as at the end of clamp cylinder strokes, the pilot of the unloading valve will be operated, the valve will be "cut in" or opened, and the pump will be unloaded. System pressure will then be maintained by the accumulator until the "cut-out" setting of the unloading valve is reached and this unit closes.

Another solution involves use of a variable delivery pump with a "compensator" control, *Fig. 19d*. The compensator automatically adjusts the pump volume to the system requirement and at the same time maintains system pressure. Thus, if the actuator volume requirements are low (as during a feeding or clamping period), the pump delivery is automatically cut back to this volume.

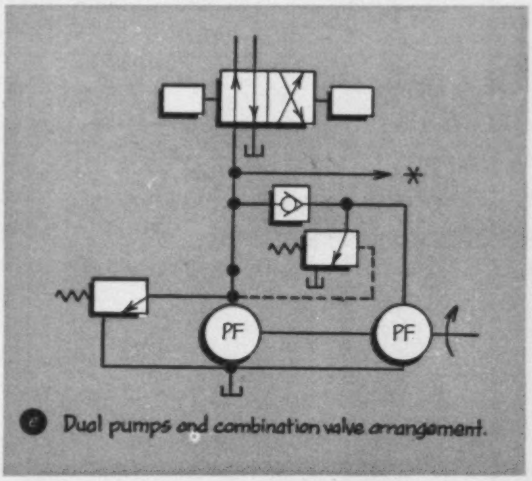
A third solution is to use multiple pumps, *Fig. 19e*. This arrangement is commonly used for operations such as pressing, clamping, and *Rapid Traverse-Feed* applications. Two pumps—one large volume and one small volume—are employed. Both pumps supply oil during large volume demand periods. When the volume requirement drops, as during *Clamp* or *Feed*, the large pump is automatically unloaded by a valve and the small volume pump maintains system pressure.

The sequencing circuits described in Parts 1 and 2 of this series cover most of the basic approaches in use today. Through variations of these approaches, a variety of complex, sequential operations can be controlled automatically. Success of a given arrangement depends, in large part, upon the manufacturing engineer's understanding of the principles, advantages, and limitations of each basic method.

Part 3 of this series, to cover adjustable speed hydraulic drives, will appear in a subsequent issue. In this article, principles, control means, performance capabilities, and applications of basic types of drives will be discussed.



d Variable delivery pump with compensator control.



e Dual pumps and combination valve arrangement.

*To control valves for additional actuators.

automation

Hydroptic-6A
SOCIETE GENEVOISE
SIP
SUISSE

Machining with Built-In Memory

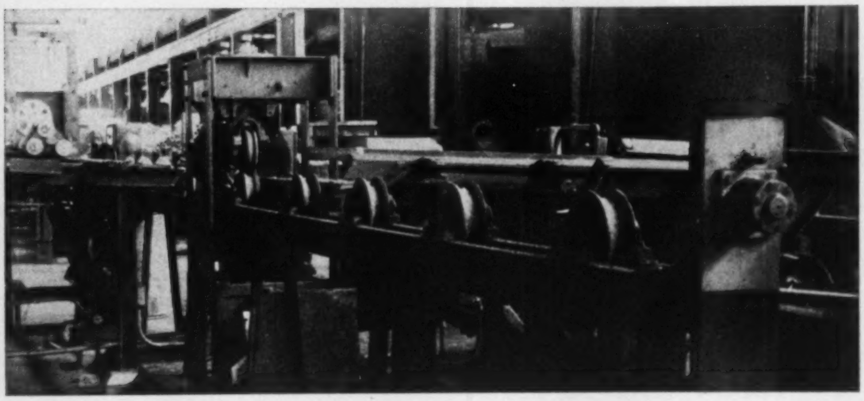
FORTY machine positions can be stored and automatically repeated within 0.00002 inch on this Swiss-made jig boring and milling machine being used by Timken Roller Bearing Co. The operator makes the first setting for a desired position by optical measurement. Thereafter he can return the work to that same position by use of a switch. Positioning information is recorded in a magnetic memory. The machine is installed in a temperature-controlled tool room and used for precision milling, drilling, boring, and facing.

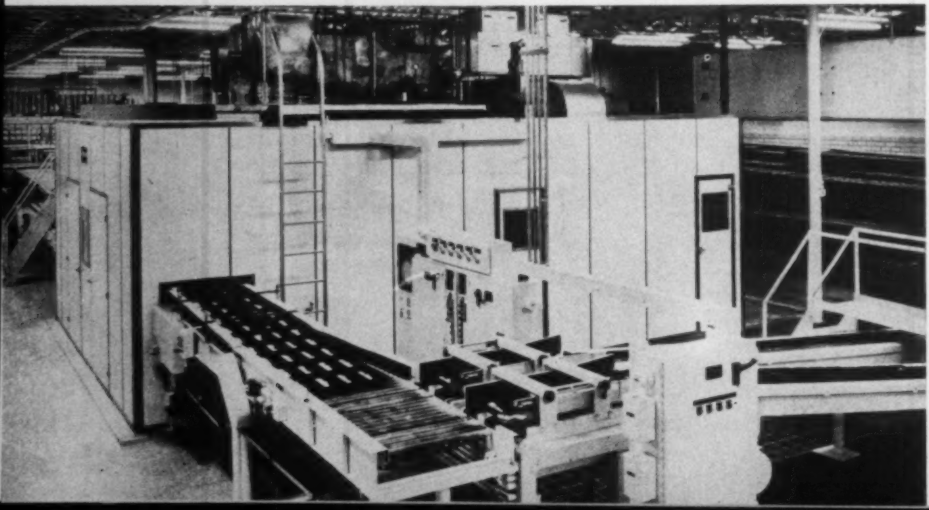
Inspecting Pallets

PALLET inspection system in a large food processing plant allows inspector to scan tops and bottoms of pallets and separate good pallets from those needing repair. As many as 20 pallets can be placed in the pallet dispenser at left. By pushbutton control the inspector releases a pallet from the dispenser and dispatches it to the appropriate stacker as determined by his visual inspection of the pallet. In the installation shown, pallets to be repaired are accumulated in the stacker at center, pallets satisfactory for use are directed to the stacker at right. Alvey Conveyor Mfg. Co. supplied the pallet inspection system.

Marking Tubes

ALUMINUM conduit in ten-foot lengths is embossed in this high-speed machine at the Kaiser Aluminum & Chemical Corp. plant in Dolton, Ill. More than 500 pieces of ½-inch conduit can be marked per hour on the equipment built by Ideal Stencil Machine Co. The installation includes an input table which feeds the tubing to the marker and a handling system to transport the conduit to an automatic threading machine. Roller dies used in the marking operation are spring loaded and can be adjusted to make impressions from 0.002 to 0.030 inch deep.

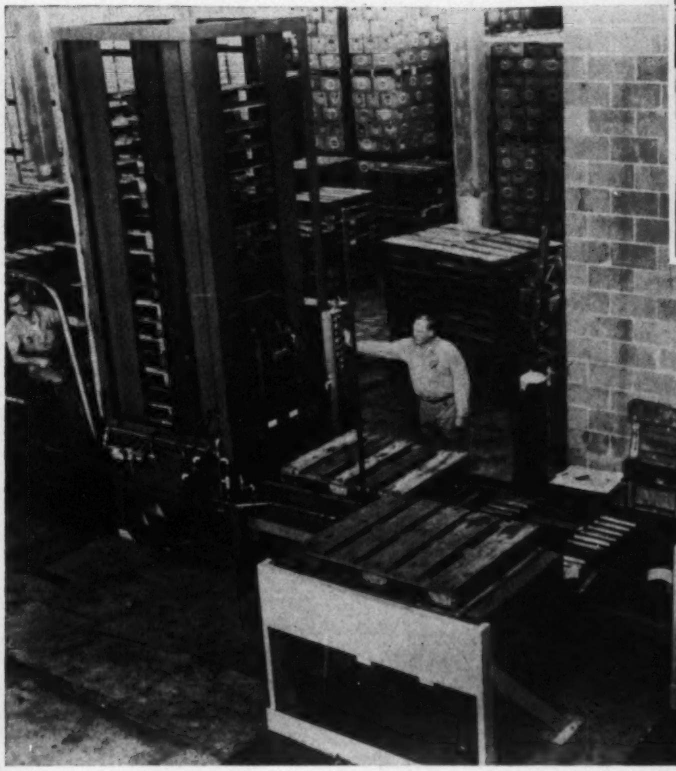




Loading Bread Pans on Trays

PANS of bread coming from the twisting area via the two conveyors at lower right are automatically grouped and loaded onto movable shelves in the proofer at rear. Release of pans from the two incoming conveyors to the conveyor loading the proofer is controlled by a photoelectric system. Number of pans loaded on each proofer shelf is adjustable, and pans are always evenly spaced across the shelf. Baker Perkins Inc. supplied the system to H. E. Butt Grocery Co.

in action

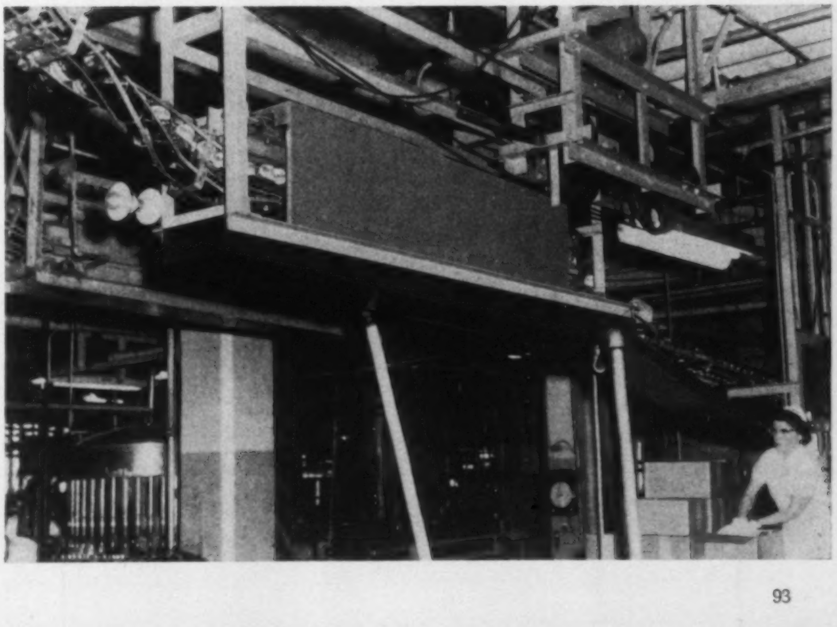


Wrapping Sauce Bottles

SPECIAL overwrap machine at Lea & Perrins wraps approximately 90 bottles per minute using a heat sealing technique. Filled, capped, and labeled bottles are fed to a rotary wrapping table. Heat-seal polyethylene coated paper, preprinted with registry marks, is fed from a roll and cut into sheets. A sheet is wrapped around each bottle and heat-sealed in place by the machine supplied by Halm Instrument Co. By heat-sealing the paper tightly around the base of the bottle's neck, the appearance of the former glued neck string design is retained, but glue is eliminated and the operation is also faster because the paper overwrap is fed from a roll.

Rinsing Cans Upside-Down

OVERHEAD can rinser at Welch Grape Juice Co. cleans 32-ounce open-end cans prior to filling. Cans are delivered on pallets from the container manufacturer and placed on a conveyor feeding a semi-automatic depalletizer and can unscrambler. As cans are moved on cableways to the packaging line they pass through the rinser at the rate of 240 cans a minute. In the rinser, cans with their open ends down are supported from above by magnetic rails supplied by Eriez Mfg. Co. A rubber belt backed by the rails replaced chains which formerly carried cans through the rinser. The new arrangement gives improved can rinsing, eliminates flange damage and line jam ups.



X-RAYS CONTROL SHEET THICKNESS

TO KEEP PACE with growing production requirements for aluminum sheet and foil, and to help reduce manufacturing costs for these products, Mirro Aluminum Co. has equipped a cold mill and a foil mill with X-ray thickness gaging and control units. Other benefits with the gaging and control equipment include higher yields per pound of raw material, greater uniformity of products, and improved production scheduling.

The foil mill, supplied by Loewy-Hydropress Div., Baldwin-Lima-Hamilton Corp., is a four-high unit that is driven directly by a 600 horsepower mill motor. Speed of the motor is governed by a VSR electronic regulator system built by Reliance Electric & Engineering Co. Another VSR system is used for the motors that drive a payoff reel, and a VSF exciter unit provides field excitation for rewind reel motors.

In the foil mill, a final pass speed of 2200 fpm can be used to roll household-type foil down to a thickness of 0.0007 inch. Rolling speeds for the first pass average 800 fpm, and intermediate passes are accomplished at speeds up to 1500 fpm.

At these rolling speeds, a former method of controlling foil thickness was inadequate. This method involved the periodic cutting of samples from the edges of moving sheets and checking them for thickness with a micrometer. Depending upon the thicknesses of samples taken in this manner, the mill was adjusted as required. However, even at relatively low rolling speeds, roll heating effects would cause variations in sheet thickness between sampling periods.

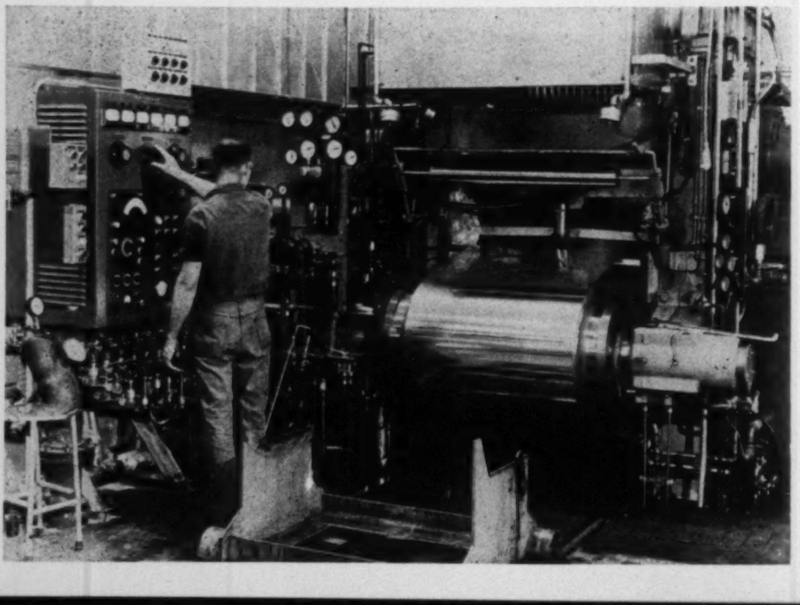
Now, an XactRay gage manufactured by Weston Instruments Div., Daystrom Inc., continuously measures and controls sheet thickness automatically once mill operating speed is attained. In operation, an energy source transmits a thin beam of X-rays from below the aluminum sheet toward a detector above the sheet. Thickness variations of the moving aluminum sheet are measured by changes in the intensity of radiation emanating from the sheet and sensed by the detector. The output of the detector is fed to electronic elements in a console. There, the radiation variations are converted into electrical signals that reflect percentage variation of actual sheet thickness from a predetermined nominal thickness. This percentage is indicated on a meter associated with the equipment.

A two-man crew operates the foil mill. Their duties include starting the metal into the rolls and removing finished coils from a rewind stand at the end of the mill. During rolling, the operators may refer to the meter and note thickness deviation percentages from nominal. A warning light flashes on the console when preset deviation limits are exceeded.

Under automatic control, the X-ray gage compensates for foil thickness variations by speeding up or slowing down the mill, thereby increasing or decreasing the tension on the sheet as required to correct the error. The gage will also shut down the equipment automatically if there is a break in the sheet or when a coil is completed.

In the cold mill, work rolls reduce the thickness of metal stock by 50 per cent on each pass. An X-ray gaging and control unit associated with this equipment automatically adjusts roll screwdown to maintain thickness tolerances. Built-in compensators correct for rolling conditions when different alloys are run.

Accuracy of the X-ray gages used with these installations is within plus or minus 2 per cent in the sheet thickness range of 0.0007 to 0.002 inch. For sheets from 0.002 to 0.025-inch thick, accuracy is within plus or minus 1 per cent.



Four-high rolling mill produces household-type aluminum foil at speeds up to 2200 fpm. Controls include X-ray gaging equipment that continuously measures and controls sheet thickness during normal mill operations.

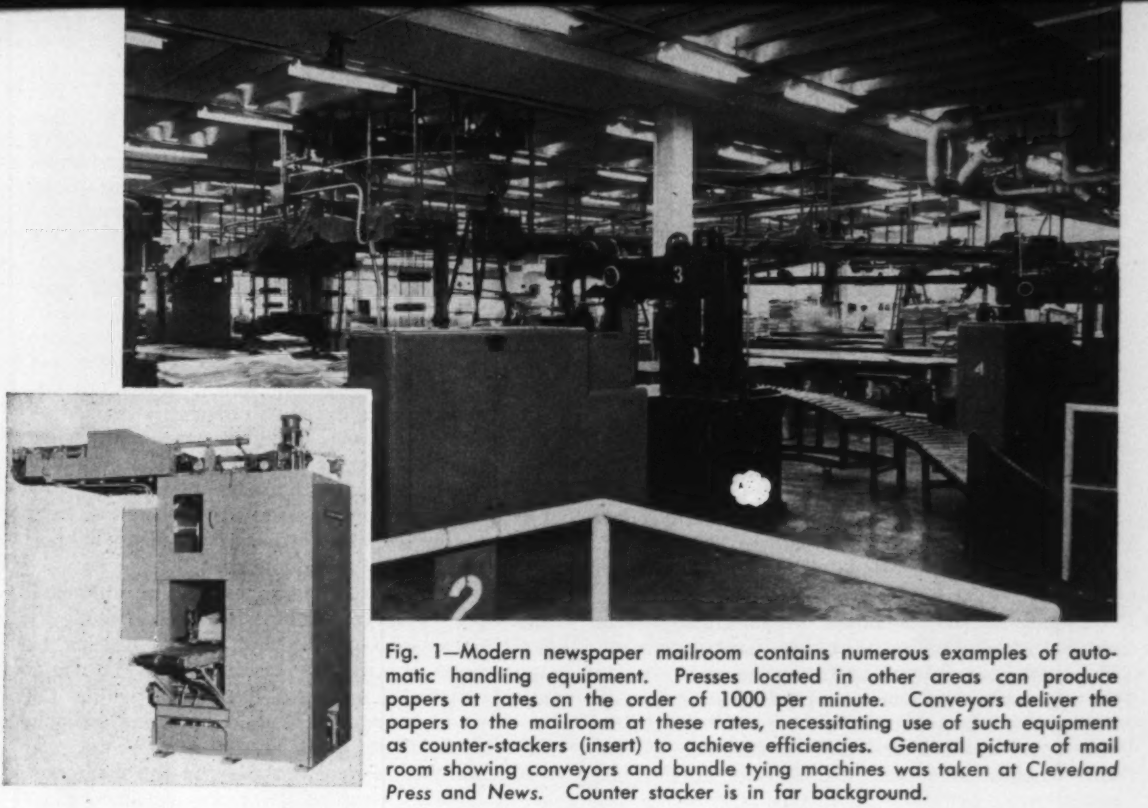


Fig. 1—Modern newspaper mailroom contains numerous examples of automatic handling equipment. Presses located in other areas can produce papers at rates on the order of 1000 per minute. Conveyors deliver the papers to the mailroom at these rates, necessitating use of such equipment as counter-stackers (insert) to achieve efficiencies. General picture of mail room showing conveyors and bundle tying machines was taken at *Cleveland Press* and *News*. Counter stacker is in far background.

COUNTER STACKER IS BASIS FOR

AUTOMATION IN NEWSPAPER MAILROOMS

When the useful life of a product is limited to only a few hours, and when it is manufactured at a central facility in quantities of hundreds of thousands—moving that product to its customers requires all the mechanical aids which are feasible. The daily newspaper is such a product. Here the author discusses equipment which speeds the handling of newspapers between the press and delivery truck.

By BYRON L. MAYS
Product Section Supvr.
Systems Control Sales Div.
Cutler-Hammer Inc.
Milwaukee, Wis.

FEW physical items are distributed to individual users so consistently, in the quantities, and with the dispatch as are local newspapers. Several general techniques which have evolved to meet the handling requirements of a newspaper are discussed in the box entitled "Distributing The Daily Newpaper." Automatic equipment has been devised to aid in the handling of newspapers in mailrooms, *Fig.* 1, and many current technological advances are opening the door to wider use of automatic devices. The purpose of this article is to highlight certain types of automatic equipment used by newspapers and to discuss systems and methods which are evolving to meet future needs.

The first problem is to get the papers from the newspaper press folder to the mailroom. This is almost always accomplished by the use of a lapped stream newspaper conveyor. For example, Cutler-Hammer has supplied such conveyors to the newspaper industry for over 40 years. These conveyors deliver newspapers to the mailroom at press speeds.

The lapped stream newspaper conveyor generally delivers the newspapers to a delivery table in the mailroom. A "kick" sheet is provided by the press folder marking every 25, 50, etc. papers in the stream. Manual "flying" is then utilized to gather the papers into stacks which are assembled in multiples of the number signified by the "kick" sheet. These stacks then continue through the mailroom process.

Counter-stacker machines are available which completely eliminate the hand flying operation. The machine developed by Cutler-Hammer receives the papers directly from the lapped stream conveyor, counts them into batches of any convenient predetermined number, and then accumulates from 1 to 4 batches (as preset) and delivers the finished stacks to the mailroom for further operations. The machine will operate at press speeds in excess of 60,000 papers per hour and is completely automatic, providing speeds, efficiencies, and savings heretofore unavailable in mailroom operations.

Bundle Tying

From the delivery table or counter stacker, the untied stacks of papers proceed on roller feeder conveyors to some sort of tying machine. Relatively few newspapers, even fairly small newspapers, still use hand methods of tying bundles. Many small newspapers use rope for tying the bundles but the rope is tied automatically by machines. These rope tying machines are fairly slow in operation. Most major newspapers today use wire to tie the bundles, and this wire is applied automatically by machines at rates generally around 20 bundles per minute. Most of the machines available on the market today use a tying method of securing the wire though there is one machine available which welds the wire to make the tie.

Before the bundles are tied, a bottom wrap and top wrap are generally applied to protect the papers from being cut by the wire tying machine and to protect them from dirt and abrasion while they are being distributed. Many newspapers use returned papers for these top and bottom wraps. For years, it has been necessary that these wraps be applied by hand. It is still necessary where returned newspapers are used although it is believed a machine will soon be on the market to apply automatically a bottom wrap of newspaper returns. Many newspapers are using kraft paper for bottom and top wraps. Again, this kraft paper can be applied by hand but there are at least four makes of machines on the market for automatically applying a kraft paper bottom wrap. With these machines, the kraft paper is loaded into the machine in the form of a roll and automatically cut to length and applied to the bottom of the stack of papers as the stack rides across the machine. Bottom wrap machines currently available operate at speeds from 20 to 27 bundles per minute although it is believed machines will be available in the near future which can operate at cyclic rates up to 60 bundles per minute.

Top wraps are still almost universally applied by hand. As stated above, these top wraps may consist of returned newspapers or in many cases, sheets of kraft paper. Particularly on those newspapers using a key bundle or complete odd count operation, kraft paper top wraps are used since they can be preprinted with labeling information.

One manufacturer has announced an automatic top wrap applying machine which automatically feeds a sheet of kraft paper on to the stack as the stack passes through the machine. This machine is still a relatively unproved device but within the next several years there should be several reliable top wrap machines available.

Still another manual operation in the mailrooms of today takes place at the tying machine. Even though most medium and large size newspapers use "automatic" wire tying machines, these machines must be manually actuated for each tie. The operator must also push the bundle into the machine and position it for a correct tie.

There are currently available a number of machines for pushing or feeding an untied bundle automatically into a wire tying machine and, when the bundle is positioned, automatically actuating the machine to make the tie. These machines are available in designs based on three basic principles: First, pushing the bundle off the feeder conveyor at right angles into the tying machine; second, pushing the bundles in an in-line motion into the tying machine; and third, a system of feeding the bundle on powered rollers in an in-line direction into, through, and out of the tying machine. Although some of these pushing or feeding machines are relatively new, a great many of them are in use in American newspapers.

To The Loading Dock

At the present time, most newspapers use systems consisting of gravity conveyors or chutes to deliver the tied bundles from the tying machines to the loading dock. These bundles are received at the loading dock at random as they are produced by the tying machines. It is necessary for men at the loading dock to then count and accumulate bundles for distribution to the correct truck loading positions. Very often, distributing belt conveyors are used, running the length of the loading dock to assist in this distribution.

A number of methods are presently available for automatically controlling this distribution. By using such a system of conveyors with pushers or diverters, it is possible to control the tied bundles from the tying machines into any desired combination of chutes to the loading dock. By adding a means of counting the bundles as they are delivered to the chutes, it is possible to control the exact number of bundles delivered at any given time to any given truck position.

One such highly automated mailroom in the United States has a series of sectionalized belt conveyors in a line which receive bundles directly from the tying machines. Spaced along this series of belts are chutes, one to each loading dock truck position. At each chute location along the distributing belt conveyors is located a pneumatically operated diverter which can divert bundles coming down the belt from either direction, into the corresponding chute. The belts and diverters are controlled automatically from a control console which has relaying circuits and predetermined counters for each chute position. The console operator can set the exact number of bundles he requires for each chute to correspond with the number of bundles required by the specific truck at each loading position. He can also select the sequence of chute loading and from then on the system is automatic. Bundles are delivered to the first chute selected until the preset number of bundles has gone into the chute. At that point, the diverter associated with that chute is retracted, and the bundles then automatically travel to the next selected chute and begin to feed to that truck loading position, until its predetermined bundle count has been satisfied, etc. There is practically no limit to the amount of automatic bundle handling which can be accomplished with equipment available today. The only limitations are available space and money. Although, where it is being applied in the United States today, this system of automatic bundle distribution and counting is generally done in the mailroom, it can also be located at the loading dock.

▶ Programmed Operations

At the present time, the newspaper stacker counter control panel contains a series of dials which are used to set the desired number of papers per batch and the number of batches per finished stack. These dials are set manually at the beginning of a run and should not be changed during the run. Thus, the stacks discharged during any given run will all contain exactly the same number of newspapers. All Cutler-Hammer stackers operating in the United States are presently restricted to this method of operation.

DISTRIBUTING THE DAILY NEWSPAPER

THE function of a modern newspaper mailroom is to receive newspapers from the presses, add preprinted supplements if necessary, gather the newspapers into bundles, secure these bundles for shipment and deliver them, generally to a loading dock, for truck shipment to distribution points. There is often another function: That of providing individual wrapping of newspapers for mail distribution. This article will deal with the bulk handling phase of mailroom operations.

There are three basic methods of newspaper distribution used in the mailrooms of today. They are as follows:

1. *A pure bulk operation.* In this method all of the papers going out of the mailroom to the loading dock are in tied bundles with the same number of papers in each bundle. The bundles are then broken up for specific news stands, paper routes, and other distribution points either by the truck drivers or at substations operated by the newspaper or by distributors. This system involves the least amount of manpower in the mailroom itself and is primarily used by large metropolitan newspapers. It places the burden for exact count for specific drop points on the truck driver or distributor.

2. *A bulk operation with key bundles.* This system also is used primarily by relatively large metropolitan newspapers. It is used where the newspaper delivery trucks carry loads which consist of many bundles. The truck driver receives as many standard bulk bundles as necessary plus a key bundle which contains the odd number of papers required to equal his exact count. For example, with 50 papers to a bundle and a requirement for 520 papers, the driver would receive ten bundles of 50 papers each and one key bundle containing 20 papers for a total of 520 papers. This system requires more manpower in the mailroom than the pure bulk operation since the key bundles must generally be hand counted and properly labeled for specific routes. Provision must be made so that the correctly labeled key bundles are available to the particular truck when that truck is loading.

3. *A complete odd count operation.* This method is generally used by small and medium sized newspapers whose circulation is primarily to home delivery routes and distribution points requiring a relatively small number of papers for each route or drop point. In this method, almost all of the bundles delivered from the mailing room contain odd counts of newspapers. The generally accepted way of achieving this is to receive papers in the mailroom in stacks with the same number of papers in each stack. The stacks are distributed down a feeder conveyor with worktables on either side. Mailers stand along these worktables, each with a supply of top wrappers which are preprinted with route information and the number of papers required for that route. The mailers then add or subtract papers to a stack to gain the desired number of papers, apply the wrappers, and send the completed bundle to a tying machine for delivery to the loading dock. This method requires by far the most manpower in the mailroom. It is also complicated by the fact that each bundle has a specific destination, and the sequence of producing the bundles and their routing must be such that the correct bundles are produced at the right time for each truck or newsboy as he arrives at the loading dock.

It is now possible to program the Cutler-Hammer counter stacker. By this, it is meant that prepunched business machine punched cards can be fed in a predetermined sequence into a card reading machine which will supply data to the stacker counter for each stack. It is then possible to have any number of papers per batch and any number of batches per stack in any stack produced by the machine. Thus, each stack delivered by the stacker can have any odd count desired as determined by the information punched on the business machine cards and within the operating limits of the machine. To accomplish this operation, existing stackers require only a minor modification to the counter input circuits. The card reader and other associated external equipment are currently available.

However, there is considerably more involved in achieving programmed automation than merely actuating the stacker to follow a punched card program. Two basic problems exist. First is the problem of properly and automatically identifying and labeling the programmed bundles as they emerge from the stacker. Second is the establishment of a co-ordinated system of preparing the program material.

Since it appears that punched cards definitely have a vital part in this programming, it would be to the newspaper's advantage to be able to use these same cards for mechanizing the business operations of a newspaper's circulation department. For example, these cards could be used for tabulating information and accumulating and sending out billings and for other record purposes. It would seem logical then that the punched cards should be prepared in the circulation department and, after they are used to program the stacker, returned to the circulation department for further use.

At the present time it probably would be necessary for a new set of punched cards to be prepared each day. A daily punching would be required not only to take care of possible changes in the number of papers to be sent to some routes but also because each card normally would contain paper count information for one bundle only. The bundle count will, however, change from day to day depending upon the size of each day's paper. For example, when 96-page papers are being run one day, it would be desirable to stack in bundles of approximately 25 papers per stack. However, the next day when perhaps 24-page papers were being run, it would be desirable to stack bundles of approximately 50 or more papers per stack. Thus, even though a given route were to receive a number of identical bulk bundles plus an odd count bundle, there would of necessity be a punched card required for each bundle each day.

By using computing type equipment it would be possible to provide a single punched card for each route giving the total number of papers on that route only. Then, by feeding a card through the computer, it would be possible for the computer to determine the number of bundles required to serve that route and the optimum number of papers

COUNTER-STACKER OPERATION

THE function of a stacker is to receive papers of a standard size from a continuous stream and convert them into stacks of predetermined count and orientation.

The counting section of the machine is concerned with conveying the papers from the press conveyor to the stacking area and counting the papers as they are transmitted. The counting section is supplied with its own drive motor which is electrically controlled by the stacker controller. Mechanically, the conveyor and counting section are linked together by an overriding clutch. The papers conveyed through the counting section will travel at a minimum speed of 105 feet per minute. When the connecting conveyor exceeds the drive speed of the counting section, the conveyor will override the counting section drive.

The papers are counted while they are travelling through the counter section by a pickup switch riding on top of a wire belt. The leading folded edge passing under the switch mechanically closes the contacts of the switch. At this point the paper stream is deflected at a declining angle which serves to eliminate top surface irregularities of the papers, insuring an accurate count, and to initiate the desired angle of flight in the stacking area.

As the papers continue down, they enter a set of pincher rollers which dish the papers to give them rigidity upon leaving the rollers. The top rollers are stationary, and the bottom rollers are spring mounted, allowing the space between the rollers to conform to the thickness of the paper stream.

Two small air-actuated paper guides deflect the paper down during stacking and then allow the paper to rise slightly during interception. Because the counting section has a minimum speed of travel the papers leaving the pincher rollers will have sufficient velocity to stack properly.

The function of the stacking area is to collect a desired number of newspapers, stack these papers into a stable vertical batch, form a finished stack from these batches, and then deliver the stack to an output conveyor for skid loading or tying.

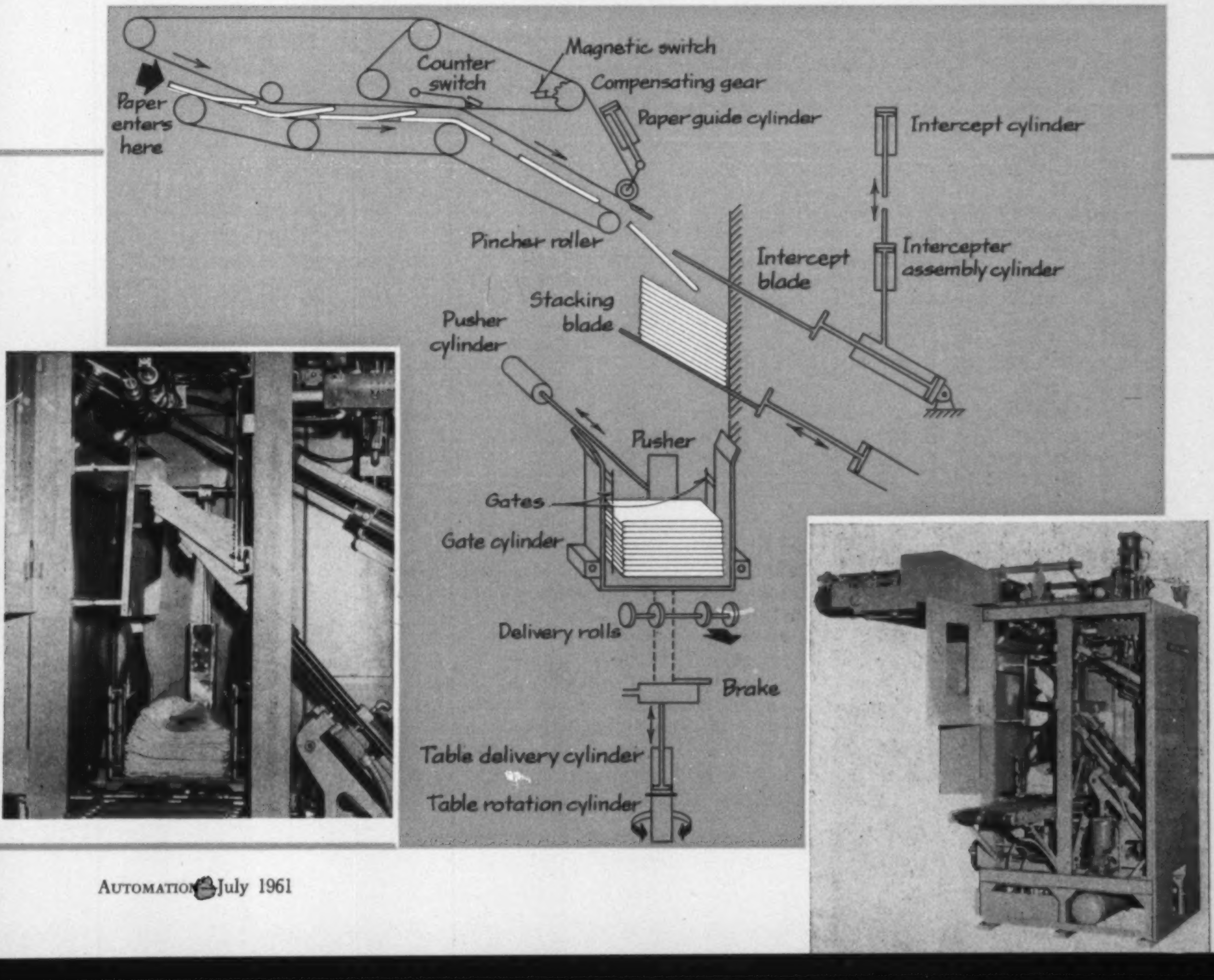
As a paper leaves the pincher rollers, it falls down and out for a short distance. The paper then hits three vertical paper guides which direct the paper onto the stacking blades. The following paper replaces it at the paper guides and is also directed down. In this way the papers are stacked vertically.

When the correct number of papers has been collected on the stacking blades, a set of interceptor blades, which are positioned parallel to and just above the paper stream, separate the stream. The blades are driven down into the paper stream in such a way that the last paper completing the batch will pass under the blades, and the first paper of the in each bundle. It would then program this information into the stacker and the bundles would be forthcoming. At the present time such a computer would appear to be quite expensive, but since the requirement is for a relatively simple, single purpose device, it should be possible in the future to market a relatively inexpensive elementary computer for this purpose.

There are several methods feasible for identifying the programmed bundles. One is to use an Addressograph type of plate with the label information and with holes punched in it corresponding to the number of papers for the particular stack and to use this plate instead of a business machine card. Thus, as the punched hole information on the card is being fed to the stacker, a label or top wrap could be printed by the plate and delivered to a man or machine to apply it to the stack as it emerges from the stacker. It would also be possible to use business machine cards with label information printed on them with a duplicating ink so the card itself can be used as a labeler by some method of spirit transfer. Another method would be to have the label information printed on the card and use the card itself as a label after it has been used to program the stack. This would preclude the return of the card to the circulation department for billing purposes. It would, however, be possible to prepare a duplicate set of cards which could be used by the circulation department.

Incidentally, since many newspapers, today, use preprinted top wrappers, it would be possible to prepare a set of punched cards at the same time the wrappers are labeled and in the same sequence as the wrappers. On a given stacker, the wrappers would be stacked in sequence at the output of the stacker, and the punched cards (in the same sequence) could be fed into a simple commercially available card reader connected to program the stacker. Thus, the counted and stacked bundles would emerge from the stacker in the same sequence as the preprinted top wraps were piled, and an operator would merely have to apply each top wrap consecutively to each stack. This would be a relatively simple operation but would require a very close co-ordination in the labeling of the top wraps and associating them with the correct punched cards in the correct sequence.

In a more completely automatic system where only punched cards are prepared, and the stackers in a mailroom are programmed from stacks of these cards, and top wrappers are simultaneously labeled from the same cards by one system or another, attention must be paid to the proper handling of



Paper enters here
Counter switch
Magnetic switch
Compensating gear
Paper guide cylinder
Intercept cylinder
Pincher roller
Intercept blade
Intercepter assembly cylinder
Stacking blade
Pusher cylinder
Pusher
Gates
Gate cylinder
Delivery rolls
Brake
Table delivery cylinder
Table rotation cylinder

the bundles after they have been counted, stacked, wrapped, labeled, and tied. Remember that these bundles are now specifically identified for a given route. Since there is no way to economically store these bundles for any period of time, they must proceed almost directly to the loading dock. A definite program of the production of the bundles is necessary, and this must be very closely tied to the truck schedule since, once the run is started, disastrous tieups could occur if the labeled bundles were not delivered to the correct loading position and if the correct truck were not there to receive them. It would appear for such a system to work that it would be necessary to completely schedule all the various aspects of the entire run. It would appear that such a system would be impractical at this time.

The Future

Because of the problems in correctly routing the labeled bundles, it would appear necessary that an even more complex system be devised. One can envision a system using a sizable computer located in the circulation department. This computer would contain memory storage into which truck number, route information, bundle information, and other circulation data was fed. It would only be necessary to change this information when a change took place in the number of papers for any given route. As each truck approaches the loading dock, a dispatcher could route the truck to any open loading position. The dispatcher would then send the information to the computer that a specific truck was at a specific loading position. The computer would scan its memory and obtain the stack information for that route. This data would be transmitted electrically to the correct stacker which would then produce the programmed bundles from the computer's instructions. As these bundles were delivered from the stacker, they would automatically be routed on the conveyor system to the correct loading position. The problem of labeling could conceivably be handled by having the computer also electrically select the proper label plate from a plate storage located at the stacker and use this plate to automatically label the stacks as they emerge. Equipment of this type is not available, and it is expected will not be available for at least five years.

It would appear that in the immediate future, automatic newspaper mailrooms will be confined to the possible. At the present time, it is possible to program a counter stacker. Programmed bundles can automatically receive bottom wraps and top wraps and be automatically tied. They can be delivered by conveyor systems to selected loading dock positions. The basic unsolved problems lie in the preparation of the programming material itself and in the problem of correctly labeling and then handling the bundles in the proper sequence after they have been stacked and labeled.

next batch will collect on top of the blades. The stacking blades then retract, allowing the completed batch to fall upon a table. While the stacking blades are retracted, the interceptor blades collect the incoming papers. To make room vertically for the papers to collect on the interceptor blades, the interceptor assembly lowers slowly. By now the stacking blades have returned to their original position. The interceptor blades are then retracted, depositing the collected papers on the stacking blades. During normal operation, the number of papers deposited on the interceptor blades will vary from three to seven.

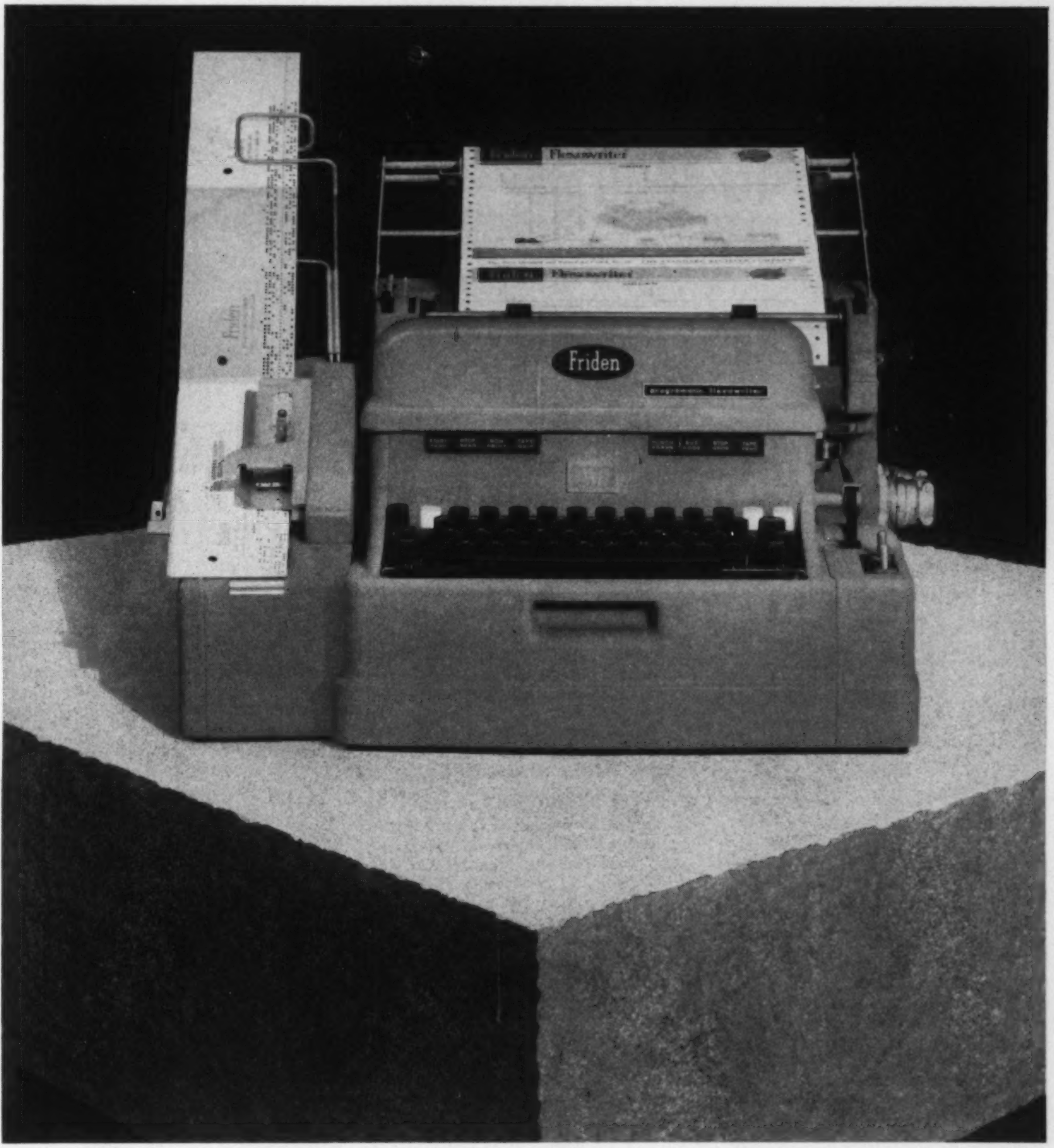
If the completed bundle is to consist of two or more batches, each new batch is placed upon the preceding batch with the folded edges on opposite sides of the stack. The alternate stacking of batches gives the completed stack stability during delivery. To accomplish this staggering, the table holding the batches rotates 180 degrees after a new batch is added. The table has four air-actuated gates which prevent the batch (es) from shifting during rotation. The table rotation is stopped by an air brake. This rotation will be completed by the time the next batch contains the desired number of papers.

When the next batch is completed, the paper stream again is separated by the interceptor blades. The stacking blades are again retracted, allowing the batch to fall upon the preceding batch. Assume this is now a complete stack ready for delivery. Again the interceptor blades will collect the incoming newspapers until the stacking blades advance to the original position. If one batch completes a stack, the stack is delivered without rotation.

To deliver the stack from the table, the table is lowered several inches, allowing a number of rotating driver rollers to protrude into the slots in the table surface. As the table lowers, the two sides of the table move outward. The paper stack is now free from side obstructions and can easily ride on the rollers. An air-actuated pusher is provided to aid in the initial start of the stack. As the stack moves off the table, two neoprene belts pick up the stack and convey it away from the machine.

The machine is quite flexible, being able to accumulate individual batches up to 109 papers per batch and from 1 to 4 batches per finished stack. The number of papers in the finished stack is determined only by the thickness of the individual papers and the operating height of the stack accumulation table in the machine, which is approximately 20 inches.

There is a limit on the minimum number of papers which can be accumulated per batch which is a function of press speed and the cycle time of the machine. At present, this minimum is approximately 25 papers at a press speed of 60,000 impressions per hour, running straight, and 13 papers, running collect, at that speed.



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Applications for the Flexowriter are immensely varied. It allows man to converse with computers. It prepares tapes that control automated machine tools. It's also bringing about a major revolution in the handling of basic business paperwork. And the surface has barely been scratched.

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THIS IS PRACTIMATION: automation so hand-in-hand with practicality there can be no other word for it.

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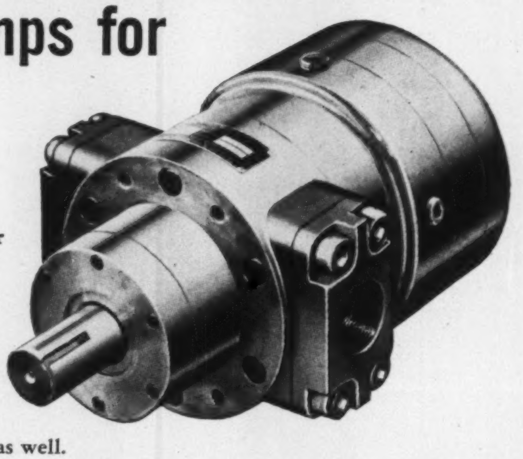


By: Ellis H. Born

Director of Sales-Engineering
Denison Engineering Division
American Brake Shoe Co.
Columbus, Ohio

Whether to use a high pressure system or a low pressure system is perhaps the most basic decision the designer faces in developing the proper hydraulic system. This decision involves such factors as efficiency, space requirements and, most important, cost.

SPACE CONSIDERATIONS

Furnishing fluid horsepower is the function of a hydraulic system. Horsepower yield is determined by multiplying system pressure (psi) times flow rate (gpm) times a constant of 0.000583. Application of this formula reveals that a 5000 psi system develops five times the horsepower of a 1000 psi system at the same rate of flow. Accordingly, the 5000 psi system requires only 20% of the flow rate of a 1000 psi system to produce the same fluid horsepower.

Reduced rate of flow permits designs which incorporate smaller valves, piping, hydraulic cylinders and reservoirs. Since reservoirs are often the largest single fluid component in a system, appreciable space savings can be realized with high pressure systems. If recommended hydraulic practice is followed, reservoir capacity is three times greater than the gpm displacement of the pump. Hence, for the same amount of fluid horsepower, reservoir capacity can be reduced as much as 80% in a high pressure system. The high pressure system not only allows savings in space through use of smaller components and capacities, but reduces the weight and mass of the hydraulic power package as well.

COST FACTORS

Use of smaller components in high pressure systems not only saves space, but affords worthwhile cost reductions.

Compact system elements cost less and because they are smaller, as well as lighter, assembly is easier and faster. Raw material requirements are also reduced. These advantages permit the over-all hydraulic system design to incorporate less weight and mass. The latter is especially important where portability is concerned.

SYSTEM EFFICIENCY

In any hydraulic system, a part of the generated fluid horsepower is used to force fluids through the system. Resultant line and pressure decreases are far less significant in high pressure systems. For example, a pressure drop of 50 psi represents a loss of 5% in a 1000 psi system, but only a 1% loss in a 5000 psi system. It follows that high pressure systems have an inherent efficiency advantage over low pressure systems.

The ability to provide sustained efficient power for a high pressure system is best fulfilled by a precision-built axial piston pump because of its low slippage rate and operating characteristics.

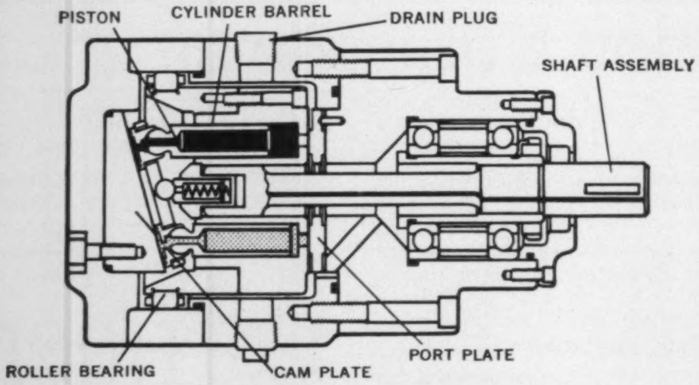
All internal forces created by hydraulic pressure against the moving parts are counteracted by the use of hydraulic balancing.

Using the principle of hydrostatic balancing eliminates the need for expensive and often cumbersome thrust bearings in the pump. This design minimizes pump size and allows a more compact pump or fluid motor package.

Other advantages are gained through hydrostatically balancing pistons and the cylinder barrel. For example, excessive loading of piston shoes against the cam plate is avoided. In addition, excessive loading of the cylinder barrel against the port plate is prevented, virtually eliminating wear caused by sliding action.

Life expectancy of internal axial piston pump parts is almost infinite since constant lubrication is supplied by system fluid.

Data and specifications on 5000 psi pumps, motors and controls are available from your Denison representative—located in principal cities—to assist you in developing hydraulic systems for maximum efficiency and economy.



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Circle 679 on Page 19

AUTOMATION

new equipment

Machines and plant equipment for more automatic operations.
For detailed information and literature, use card Page 19.

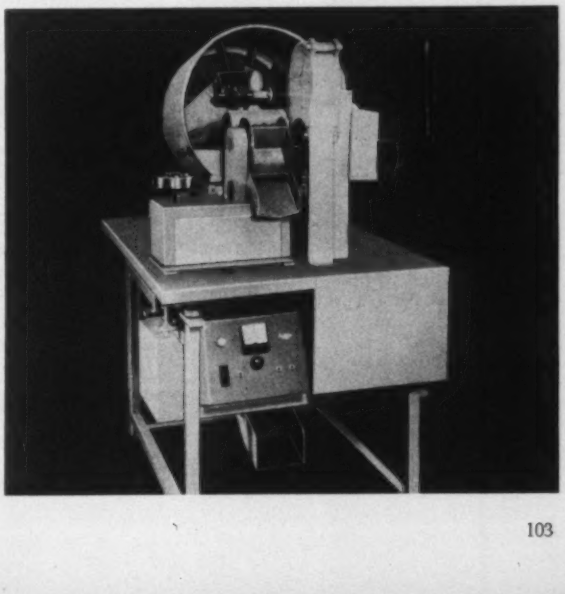
Electronically Controlled Parts Counter

HIGH-SPEED, automatic parts counter, which bulk counts and also batches in small lots, handling up to 450,000 items per hour, has been developed by **Atronic Products Inc.**, West Conshohocken, Pa. Model 620 handles an unusual variety of parts sizes and shapes ranging from paper clips, ball bearing assemblies, and fasteners of all types to candy and drug capsules. Items can weigh between 0.01 and 2.5 oz and can range in size up to about two inches. Applications include packaging, prepackaging, bulk shipping, inventory control, incoming inspection, and production batching. Feature of this machine is its flexibility which permits fast changeover in counting different parts. Changeover time is about two minutes.

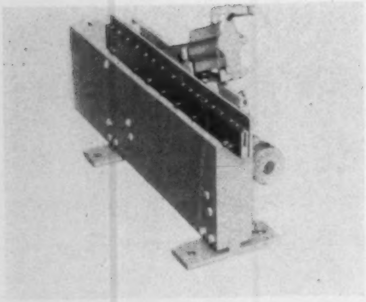
Basic principle of operation of this parts counter is automatic, high-speed weighing of parts in sufficiently small batches to permit an accurate count by weight regardless of manufacturing tolerances of the parts. Operation is as follows: Incoming parts are fed into the continuously revolving hopper whose rotary motion lifts the parts and completely fills the precision measuring cup. A cam then jolts the cup in a leveling action. Volume of the cup is adjustable to hold within close tolerances the precise number of pieces desired in each package or batch. Depending on the user's requirements, batches are preset anywhere between six and several hundred pieces. The cup then dumps the measured parts into a scale pan where they are rapidly weighed by the electronic scale to determine exact count of the batch. This count is then tested automatically to determine if it falls within preset acceptance limits. If within limits, the batch is deposited in the output chute to the waiting container or tray. If not within limits, the batch is returned to the hopper. The visual indicator gives exact count data if within limits, or shows if batch is overweight or underweight. Acceptance limits can be preset to allow any deviation up to plus or minus six pieces. If zero is preset as the acceptance limit in batches of 25 pieces, the machine will deliver only 25-piece batches to the output chute. All other batches such as 24 or 27 are returned to the hopper. This is exact batching. However, if plus one is preset as the acceptance limit, the machine will accept batches of both 25 and 26, which results in a one-half piece average giveaway. This is approximate batching. Approximate batching is justifiable in cases where the higher rate of package filling more than offsets the small giveaway. Both modes of operation can be fully automated by use of a conveyor which handles open cartons or trays and is actuated at the proper times on the machine.

By accumulating consecutive batches delivered by the counter, it is possible to do bulk counting in any desired large quantities. A total running count of the variance of each batch is maintained by the visual numerical indicator. Individual batch variances tend to cancel out on long runs. The machine automatically stops at the end of the run and indicates the final small variance which is compensated for by the operator. An exact count of 10,000 average size pieces can be achieved in about five minutes of unattended operation.

Circle 401 on Page 19



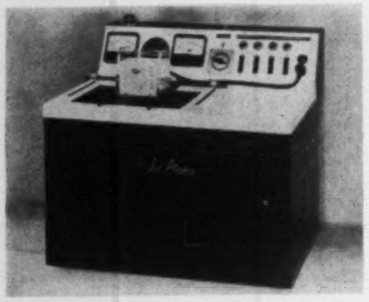
Fast changeover, fully automatic parts counter counts and batches mass produced items in exact quantities. Both exact batching and approximate batching can be fully automated by use of a conveyor which handles open cartons or trays and is actuated at the proper times by a control on the counter.



TRANSFER FEEDERS CAPABLE OF CONVEYING ALL SHAPES AND SIZES OF PARTS

Vibron vibratory transfer feeders feature unique ability to operate in explosive atmospheres. All shapes and sizes of parts can be conveyed rapidly and dependably in a horizontal direction. Custom tracks are attached to flat surfaces. Two speed drives and track supply monitors are available to provide a controlled reservoir of parts for use in escapements. Stable feeding action is available up to 700 inches per minute. The feeds are available in standard models up to six feet in length. Operating pressure range is from 20 to 150 psi. Low air consumption characteristic of the feeders varies from 1/8 to 2 1/4 cfm according to the speed required. **Burgess & Associates,** 3790 W. 150 St., Cleveland 11, Ohio.

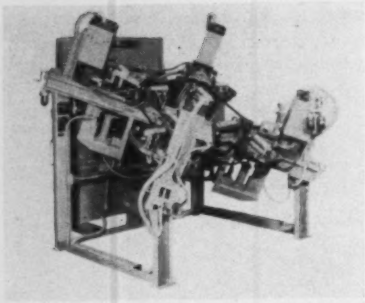
Circle 402 on Page 19



PRECISION PLATING MACHINE SUITABLE FOR ELECTRONIC PARTS

Plating unit, measuring 30 by 26 by 18 inches to the work top, contains all the equipment and features for precision-plating of jewelry, electronic parts, specification precious metal plating, or pilot plant setups. It permits either barrel or rack plating with any cold alkaline solution, and most acid plating solutions, on a mass-production basis. The plater provides the ideal operation of precision-plating, i.e., a plastic centrifugal pump in conjunction with a vinyl, jet orifice manifold at the bottom of the plating tank causes the plating solution to swirl constantly around the work, assuring smooth, even deposits. All operations are controlled by a panel board. **Meaker Co., Subsidiary, Sel-Rex Corp.,** Nutley 10, N. J.

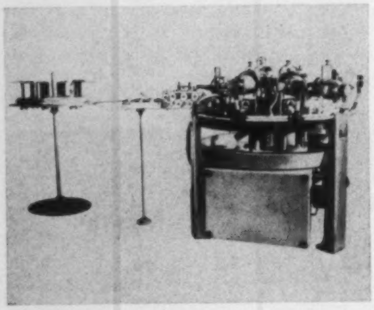
Circle 403 on Page 19



PROJECTION WELDER CAPABLE OF WELDING 450 ASSEMBLIES PER HOUR

Multi-gun inclined projection welder projection welds hinge brackets and leg assemblies to the top rim of card table frames. It consists of an inclined frame mounting four dual welding gun units, one for each of the four hinge bracket and leg assemblies, together with the necessary transformer, clamp, locators, and gun and transformer mounting bracket at each corner. The machine is made adjustable for various card table sizes. Four package type transformers furnish the weld power. All necessary air, water, and electrical accessories, complete with piping, wiring, etc., are provided for the proper automatic operation of the machine. **Federal Machine & Welder Co.,** Warren, Ohio.

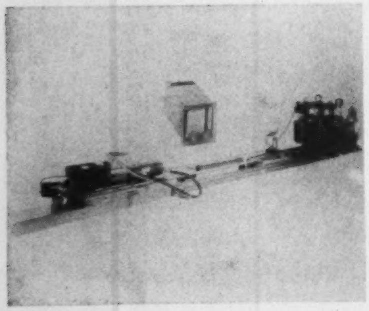
Circle 404 on Page 19



AUTOMATIC INDEXING MACHINE PRODUCES SMALL PARTS

Machine has been developed for the production of small parts up to 3/8 by 1 1/2 inches in ferrous or nonferrous metals. It is ideal for fast production of contact brushes, clips, plug pins, and similar parts for the electrical industry. Up to nine operations can be performed with a production rate of approximately 2100 parts per hour in a continuous uninterrupted flow of finished parts. Operations performed by the Amba Automatic (German) include wire straightening, cutting, drilling, tapping, milling, slotting, etc. Rounds, hexes, squares, etc. or profile material in coil or bar form can be easily and quickly processed by this machine. **Imported Machinery Sales Co. Inc.,** P. O. Box 148, Berea, Ohio.

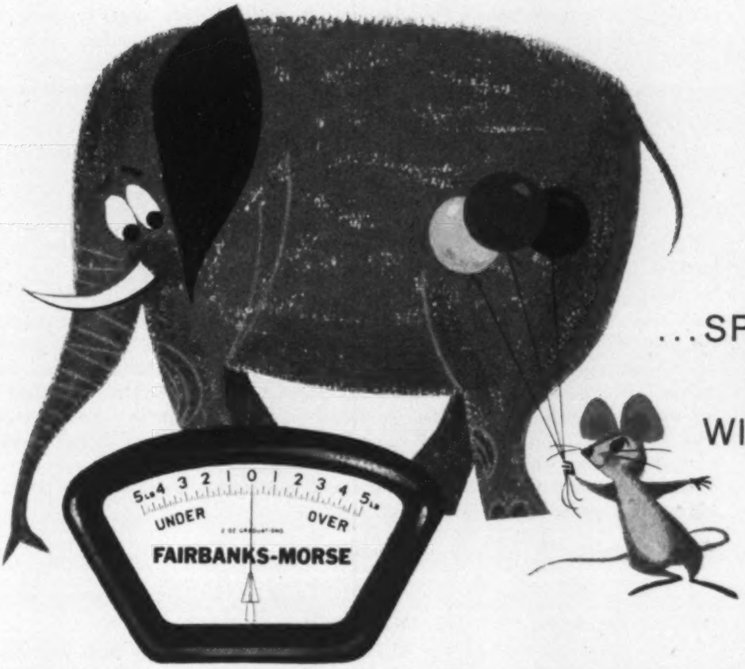
Circle 405 on Page 19



WEB WIDTH RECORDER PROVIDES CONTROL INFORMATION

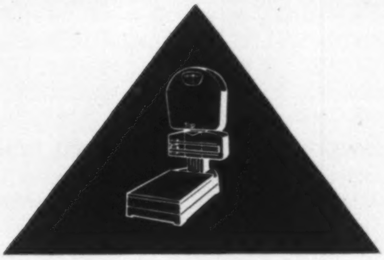
Device will indicate and permanently record any web width change and will operate on an infinite variety of web or cloth widths. Components of the unit are completely preassembled, and it is furnished as a packaged unit. Complete assembly consists of a Model M50-2 multiple automatic web guide power unit, proper sensing heads, hydraulic cylinders, pneumatic motion transmitter, and pneumatic strip or circular chart recorder with an electric chart. The unit can be installed and relocated with a minimum amount of installation time. One variation of the device may be used to automatically guide the web as well as record the width changes. **Fife Manufacturing Co. Inc.,** P. O. Box 9815, Oklahoma City 18, Okla.

Circle 406 on Page 19



...SPEED UP
CHECK WEIGHING
WITHIN SPECIFIED
TOLERANCES

FAIRBANKS-MORSE "OVER-UNDER" SCALES



For check weighing requirements that permit a tolerance, over or under, of ½ ounce or more, the F-M Floaxial "Over-Under" Dial Scales are the answer. Specifically designed for check weighing within close tolerances, these units, in most cases, provide the widest spaced graduations with consequent easier reading, than any other like units.

Two types are available: The F-M Bench Dial Scale and the F-M Portable Dial Scale. The simple, compact Bench Scale is rugged and lightweight... available in various sizes with capacities from 130 to 800 lbs. The Portable Dial Scale, ranging in capacities from 325 to 800 lbs., has smooth-rolling rubber wheels for easy movement.

Electrical and electronic controls and signals to suit your check weighing requirements can be furnished. Both the Bench and Portable "Over-Under" scales have main and fractional tare bars and the direct-reading F-M "Floaxial" Dial that eliminates knife edge or pin point pivots.

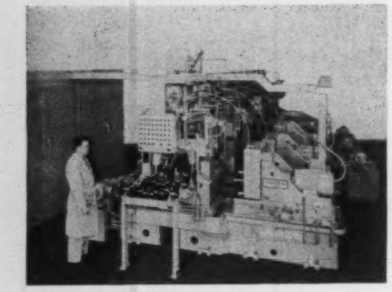
For more information on either the bench or portable model "Over-Under" scales, write: **C. G. Gehringer, Marketing Director; Scale Division; Fairbanks, Morse & Co., 100 Electra Lane, East Station; Yonkers, New York.**

FAIRBANKS MORSE

A MAJOR INDUSTRIAL COMPONENT OF

FAIRBANKS WHITNEY

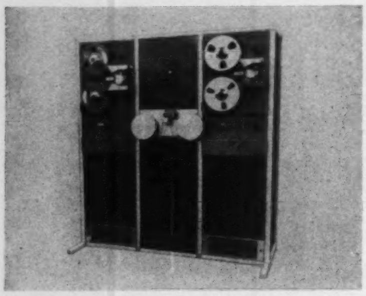
Circle 680 on Page 19



TWENTY-STATION TRANSFER MACHINE HANDLES CRANKSHAFTS

Building block transfer machine drills, reams, taps, chamfers, and precision bores 78 automotive engine crankshafts per hour at 100 per cent efficiency. It is made up of five separate machining segments and a motorized chip conveyor. For rough and finish precision boring operations on the center hole in the crankshaft flange, the parts rather than the boring tools are rotated. An in-process gaging operation that probe-checks six holes for completeness or broken drills with a hydraulically operated probing plate is provided at the eighth station. **Snyder Corp.**, 3400 E. Lafayette, Detroit 7, Mich.

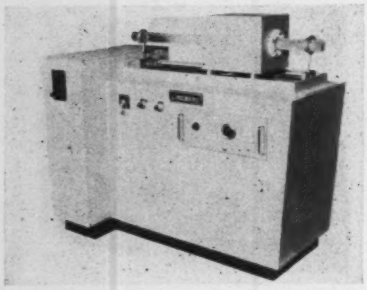
Circle 407 on Page 19



SYSTEM CONVERTS DATA FROM PAPER TO MAGNETIC TAPE

Solid-state system extracts data from punched paper tape and writes it on magnetic tape. This data conversion is accomplished by Model 1433 so that input and output data are completely identical in content. No code change is normally performed, with the output record being a bit for bit image of input perforated tape except for certain format changes. The system will accept paper, foil, or plastic tapes in widths varying from 5 through 8 level. It can write data on magnetic tape in formats compatible with IBM 727, 729 Mod 1 and Remington Rand computer inputs. System includes a paper tape reader capable of reading 120 characters per second, a magnetic tape handler, and necessary electronics for control and tape format. **Tally Register Corp.**, 1310 Mercer St., Seattle, Wash.

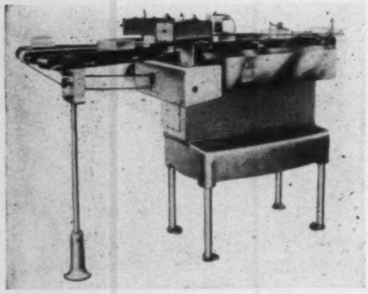
Circle 408 on Page 19



HORIZONTAL ZONE LEVELING AND REFINING FURNACE

Horizontal zone leveler, Type RHR2-1Z23, is a completely packaged unit designed for applications such as zone leveling of germanium bars up to 18 inches long, and zone refining of such materials as potassium chloride or bromide. It is usable for epitaxial growth along with straight diffusion processes. The furnace has a maximum operating temperature of 1093C. The chamber is 3 inches long and is heated by two ring type nichrome heating elements which provide a uniform heated length of 1 inch at ±2.0C. Maximum linear travel of the unit is 24 inches. Scanning speed is variable from 0 to 0.9 inches per minute in either direction. **Semiconductor Div., Lindberg Engineering Co.**, 2444 W. Hubbard St., Chicago 12, Ill.

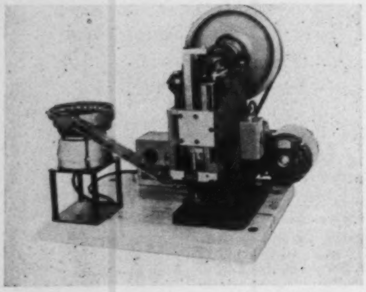
Circle 409 on Page 19



UNIT PROVIDES EFFICIENT CHECKWEIGHING OF OPEN UNSTABLE CONTAINERS

At any speed up to 300 per minute, Model 600 checkweigher receives production from any packaging operation, weighs each article on the fly, and instantly diverts off-weights from the line. Open cans, jars, bottles, cartons, even flexible pouches and bags are accurately checkweighed. Ultra-smooth travel of the machine's single, endless belt provides maximum stabilization of the container before it gets to the scale and during the split-second when it is weighed and classified. This checkweigher is equipped with adjustable legs and fits almost any production line. Both a three-way and two-way segregation system is available. **Packaging Machinery Div., Food Machinery & Chemical Corp.**, 4900 Summerdale Ave., Philadelphia 24, Pa.

Circle 410 on Page 19



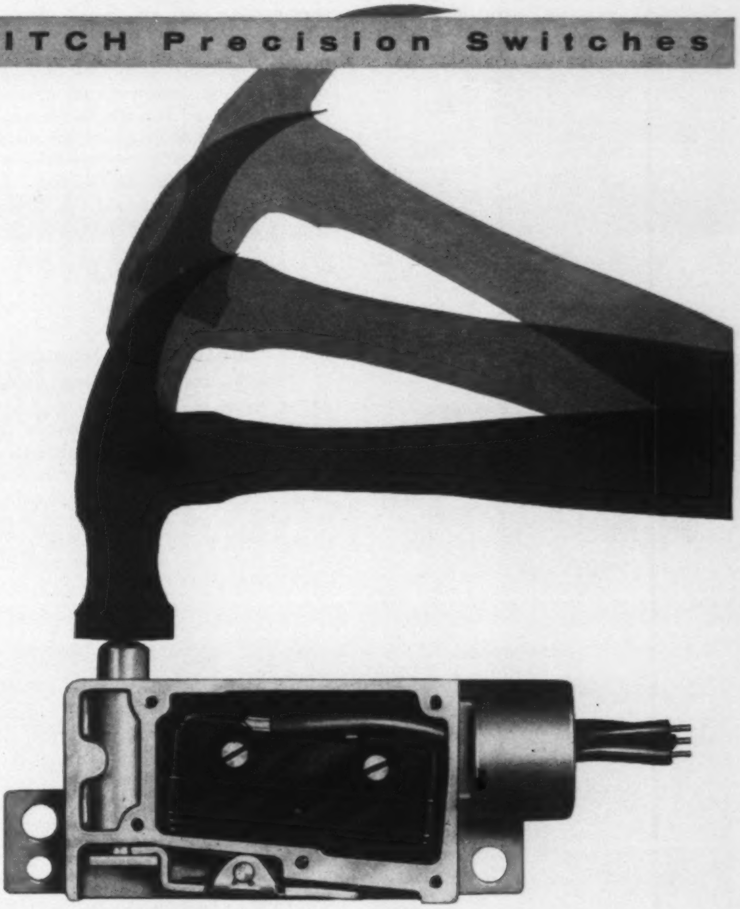
TURRET TERMINAL RIVETER FOR ELECTRICAL AND ELECTRONIC INDUSTRIES

Riveting machine inserts and sets electronic terminals and base pins at high speeds. It is ideally suited for setting electronic terminals in printed circuit boards and other electronic components. Model 900 is operated by an electric foot switch. A vibratory hopper is employed to insure continuous flow of the terminals to the riveting jaws. Electrically interlocked limit switches provide fail-safe operation. Hopper and track handle varying lengths of turret terminals with no change in tooling. The machine is supplied complete with 1/3 hp 110 v ac motor. **Eyelet Tool Co.**, 31 Carleton St., Cambridge 42, Mass.

Circle 411 on Page 19

H HONEYWELL **MICRO SWITCH Precision Switches**

THESE SWITCHES ROLL WITH THE PUNCH – DON'T GET HURT!

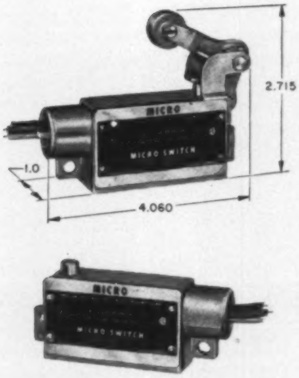


HAMMER-BLOW HERE
Impact actuation of the external plunger is absorbed by a specially designed operating mechanism.

FEATHER-TOUCH HERE
A controlled force is transmitted to the diaphragm-sealed plunger of the internal switching unit.

The MICRO SWITCH "LN" Switches are compact, but rugged! The high-strength enclosure and the special design of the actuator combine to withstand rapid, hammer-blow operation. A diaphragm completely seals the actuating plunger. The No. 14 insulated leads are sealed at the conduit hub. A gasket inside the cover completes the seal against oil and dust.

Two contact arrangements are available: single-pole double-throw and two-circuit double-break units. Check the compact size and you'll find that "LN" Switches fit where other switches can't! See the Yellow Pages for the nearby MICRO SWITCH Distributor or write for Catalog 83.



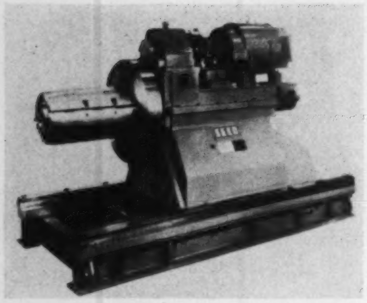
Plunger Actuator switches and Roller Arm Actuator switches are both available in either left hand or right hand designs.

MICRO SWITCH . . . FREEPORT, ILLINOIS . . . A division of Honeywell
In Canada: Honeywell Controls, Limited, Toronto 17, Ontario

H HONEYWELL **Honeywell**
MICRO SWITCH Precision Switches

HONEYWELL INTERNATIONAL
Sales and service offices in all principal cities of the world. Manufacturing in United States, United Kingdom, Canada, Netherlands, Germany, France, Japan.

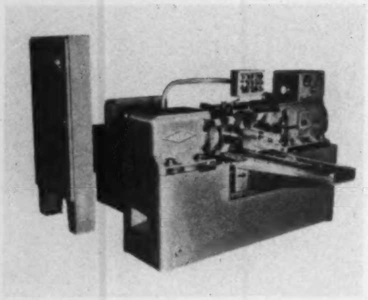
Circle 681 on Page 19



PROCESSING-LINE UNCOILER SUITABLE FOR DRIVE SLITTING

Unit can provide precisely controlled tension on light-gage slitting or processing lines. It features a totally enclosed, oil-tight gear drive and a drag-generator unit which maintains strip tension during slitting and also supplies power for feed while the strip is being threaded through the slitting line. The uncoiler can move forward, accept an incoming coil, and reposition for the drive slitting operation. A hydraulic cylinder positions the device. Optional equipment includes a 3-segment mandrel, driven hold-down rolls, and automatic edge control. The uncoiler normally has a 4-segment expanding mandrel. **Steel Equipment Co.**, 20805 Aurora Rd., P. O. Box 737, Cleveland 22, Ohio.

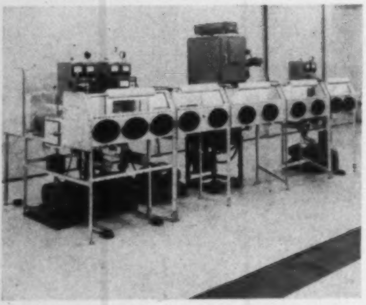
Circle 412 on Page 19



THREAD ROLLING AND FORMING MACHINE

Designed for heavy thread, form, spline, and gear rolling applications requiring rolling forces of up to 200,000 pounds, Hy-Duty thread rolling and forming machine has a nominal diametrical capacity of from 0 to 6 inches maximum for infeed rolling. Maximum diameter for through feed rolling is from 0 to 4 inches. Thread lengths of 11½ inches are obtainable for infeed rolling, up to 20 feet for through-feed. Equipment is hydraulically operated, infinitely regulable, and provided with electronically controlled infeed cycling and variable infeed stroke length. **Landis Machine Co.**, Waynesboro, Pa.

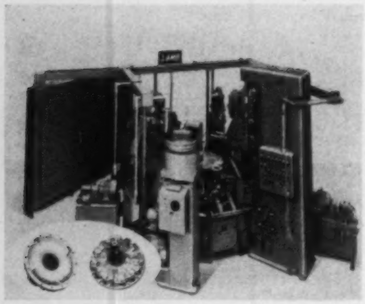
Circle 413 on Page 19



CONTROLLED ENVIRONMENT PRODUCTION SYSTEMS

System includes dry boxes, dust shields, vacuum ovens, and accessories for precise control of purified atmosphere for manufacturing, assembly, and testing precision components and parts. Transistors, diodes, rectifiers, and new solid state electronic devices are examples of the small components which must be fabricated and sealed moisture and dust free under controlled atmosphere conditions. System was originally designed for an automated transistor production line. When in operation, it provides 5 microns of oven vacuum and maintains less than 10 parts per million of water vapor. **Lansdale Div., Philco Corp.**, Lansdale Pa.

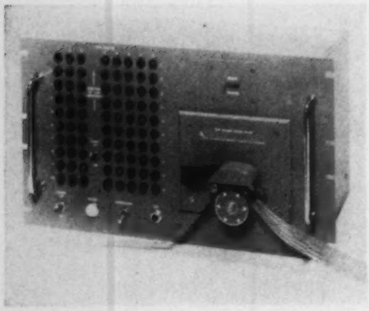
Circle 414 on Page 19



DIAL INDEX UNIT COMBINES ASSEMBLY AND MACHINING

Machine performs assembly, drilling, spotfacing, and straddle milling operations in processing 212 transmission cover torus assemblies per hour at 100 per cent efficiency. It features tilting quill units that lower a bushing plate into the center hub of the part to obtain tool stability and accuracy in drilling an integral oil hole. Standard building blocks are mounted around a 48-inch cam actuated indexing table to form 10-station machine. Hydraulic and electric components meet J.I.C. Standards. **F. Jos. Lamb Co.**, 5663 E. Nine Mile Rd., Detroit 34, Mich.

Circle 415 on Page 19



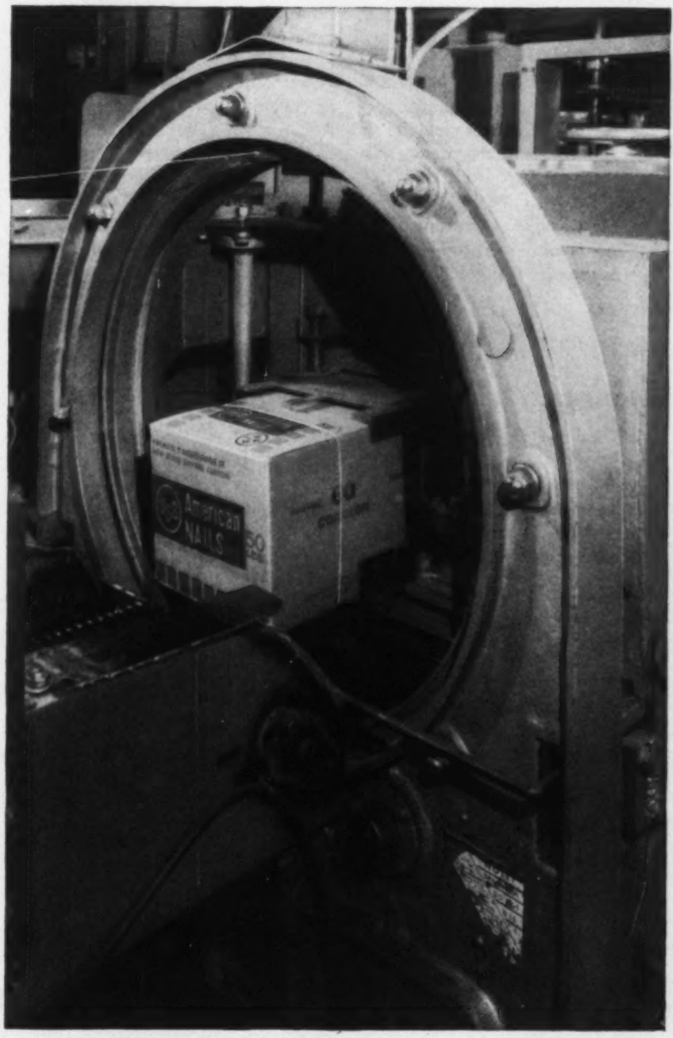
TAPE READERS READ 80 BITS OF INFORMATION SIMULTANEOUSLY

Two tape readers for automatic programming employ 8-level standard perforated tape. Models 401 (shown) and 402 read 80 bits of information at 6 tests per second and will locate a test program rapidly at 12 inches per second. The tape is advanced one frame at a time on a command signal which is a simple SPST switch closure. Model 401 has a verifier panel which shows a full frame hole pattern on the front of the unit. Model 402 is an identical unit except without the verifier panel. A frame counter indicates the number of frames the tape has advanced from any given starting point. The counter can be reset with a front panel control. **Automation Div., Electronic Engineering Company of Calif.**, 1601 E. Chestnut Ave., Santa Ana, Calif.

Circle 416 on Page 19

IT'S BOUND TO BE BETTER WITH A USS STEEL STRAPPING MACHINE

A machine like this can save you $6,000 a year...and more!



It's the USS Model 12 Automatic Round Steel Strapping Machine. The Joliet Works of U. S. Steel's American Steel and Wire Division uses it to strap all their nail cartons. Formerly, it was necessary to stop the conveyor line about 20 times per day to change carton sizes. Each change-over took over five minutes. With installation of the Model 12, the change-over takes only a matter of seconds. Previous strapping methods required two-way tying for sufficient strength. This has been eliminated with the round steel strap. Now, one round steel strap gives the same strength, thus reducing strapping costs by shaving material needs by thousands of feet per day.

At ASW, the Model 12 straps thousands of nail cartons daily with strong, 16-gauge USS Round Steel Strapping. In addition to practically eliminating change-over time, the labor-saving Model 12 takes only 7½ sq. ft. of floor space and weighs only 1,300 pounds.

Find out how the automatic Model 12 can help cut costs and speed production in your operation. See our new industrial film showing many possible applications for the Model 12. Send the coupon.

U. S. Steel Supply
Division of
United States Steel

TRADEMARK

U. S. Steel Supply
U. S. Steel Corporation
208 South LaSalle Street
Chicago 4, Illinois

Please send me more information on:

☐ USS Model 12 Automatic Round Steel Strapping Machine.
☐ The new industrial film entitled, "Tie This."

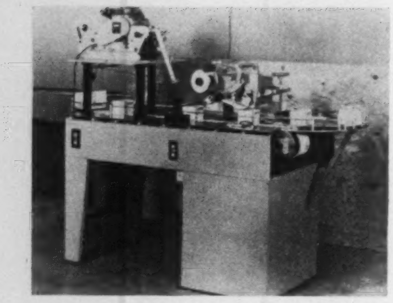
Name____________________

Company____________________

Address____________________

City__________ Zone____ State______

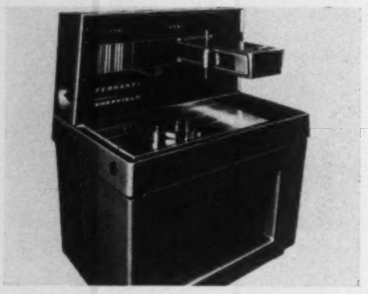
Circle 682 on Page 19



LABELER-IMPRINTER APPLIES WIDE RANGE OF PRESSURE-SENSITIVE LABELS

Designated Model 250 labeler-imprinter-conveyor, this machine is engineered to automatically imprint and apply a wide range of pressure-sensitive labels at variable speeds. The imprinter is electrically coupled to the labeler, and automatically feeds printed labels as required at speeds up to 120 per minute. This machine enables packagers to inventory plain or partially printed pressure-sensitive labels, imprint them with variable information and apply to packages automatically in one operation. Conveyor speed is variable from 1 to 110 feet per second. Labels from $1\frac{5}{8}$ inches by $\frac{1}{2}$ inch to $4\frac{3}{4}$ by $4\frac{1}{2}$ inches are handled. **Avery Label Co.**, 1616 S. California Ave., Monrovia, Calif.

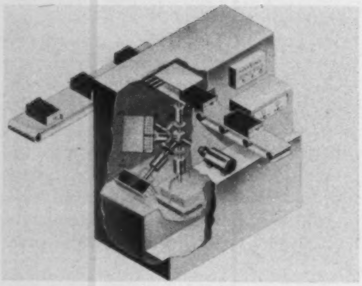
Circle 417 on Page 19



MEASURING MACHINE USED FOR MEASURING OF LOCATION OF HOLES

Machine is used for fast, precise measuring of the location of holes and surfaces of parts in two dimensions. It displays the X and Y coordinate readings simultaneously by means of lighted numerals on the panel above the gage table. Gaging accuracy obtained over the 15-24 inch range is better than 0.001 inch. This machine can also be used for layout and scribing operations; to center punch precision parts with highest accuracy; and through the use of air or electronic gage cartridges or a toolmaker's microscope, to handle a large variety of inspection problems. In operation, the workpiece is positioned on the table, and the movement of the gage probe from reference position through X and Y coordinates is read on the digital panel. **Sheffield Corp.**, Dayton 1, Ohio.

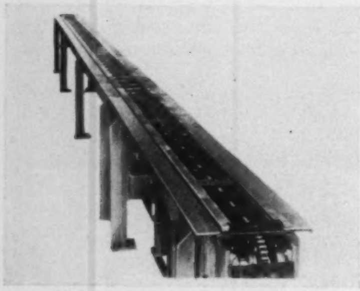
Circle 418 on Page 19



ULTRASONIC LOADED TOTE BOX CLEANER

Developed to automatically load, ultrasonically clean and degrease, dry, and unload tote-box loads of metal parts, the Auto-Sonex V-72 is particularly useful for delicate assemblies and parts that cannot tolerate impingement or tumbling. It features flexibility in selection of solvents, water solutions, and acids for cleaning and degreasing. Two to four tote-box loads per minute can be processed. The machine also features its own solvent purifying by distillation. Functional stages of its operation are: Loading and indexing, vapor degreasing, ultrasonic cleaning combined with solvent immersion, distillate spray rinse combined with vapor rinse, draining and drying, and unloading. **Autosonics Inc.**, 4217 Chestnut St., Philadelphia 4, Pa.

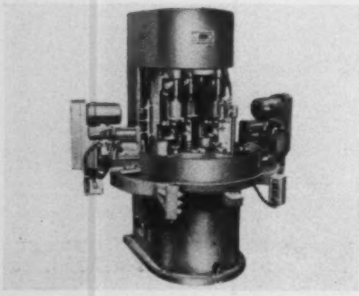
Circle 419 on Page 19



INDEX CONVEYOR IDEALLY SUITED TO AUTOMATION OR PACKAGING LAYOUTS

Manufacturing indexing in-line conveyor features usually flexibility and capacity. Power and length of index can be varied to suit any demand condition. Indexing movements of 100 per minute have been achieved, and strokes of any length are possible. These conditions are met with tolerances of 0.002 inch. Bed and platens can be made to suit any structural requirements. Operating stations can be mounted on the frame, which can accommodate work stations of any size or position. **Gaynes Engineering Co.**, 1646 W. Fulton, Chicago 12, Ill.

Circle 420 on Page 19



SECONDARY-OPERATION MACHINE FEATURES SIMPLICITY OF INDEXING

Secondary-operation machine, designated Standard M-S-O, performs many multiple secondary operations such as spot facing, countersinking, chamfering, centering, tapping, eccentric turning, milling, deburring, counterboring, box tooling, threading, and hollow milling. It is capable of performing several operations simultaneously. This machine offers cost reductions through simplicity of indexing and operation and by the elimination of such individual units as hand screw machines, drill presses, light milling machines, tapping and threading machines, and many other single purpose machines. **Standard Tool & Manufacturing Co.**, 738 Schuyler Ave., Lyndhurst, N. J.

Circle 421 on Page 19

Circle 683 on Page 19→

POST

ELECTRONIC PRODUCTS and CONTROL SYSTEMS

ASSURE:

RELIABILITY • ACCURACY
LOW MAINTENANCE • PRODUCTION CONTROL

Post's *proven* electronic counters and control systems are in widespread use throughout industry. Serving such diverse needs as batch counting, measuring, sensing or machine control. Post electronic products are ideal production aids.

Note these examples of Post's broad line of Electronic Products . . .

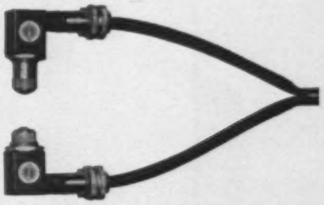
COUNTERS

SD-1T Outmodes mechanical counters. Will operate at speeds up to 100 units per second. Single 'count' registers on visual totalizer as each 10th. item breaks beam. Note: 12 place tube available for counting dozens or gross lots.

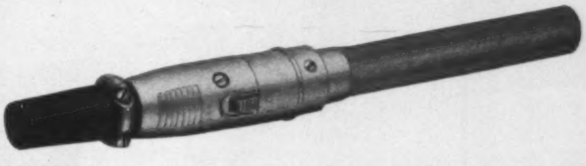
P-5 Preset counting of any desired 'batch' — 1-100,000 units. Other models available for 10,000 or 1,000,000 range. Direct 'batch' readout on all models from totalizer . . . quantity less than 'batch' shown directly on tube face (s).

PW-5 PRESET Counter with BUILT-IN WARNING SYSTEM. Model shown will 'batch' count 1-100,000 units (inclusive) and warning selection dials may be set to energize a secondary control circuit, i.e., 'Batch' count desired 5000 . . . warning count desired 4900. When warning count reached, impulse may be given to flash light, operate solenoids for opening or closing feed gates, etc.

SENSING DEVICES

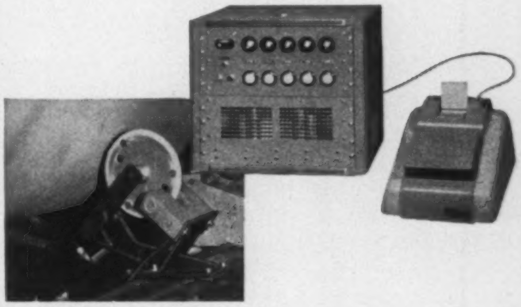


H-21-C A miniature, all purpose photohead. Ideal for limited space application. 'Head' not much longer than standard paper clip. Exciter lamp life 5000 hours. Utilizes photosensitive semi-conductor cell.



MH-2-P A new, compact magnetic switch in neat epoxy resin shell. . . . Magnetically operated as sensing device, the MH-2-P is capable of speeds up to 100 cycles per second — long life — no "bounce".

CONTROL SYSTEMS



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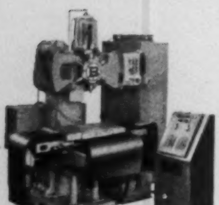
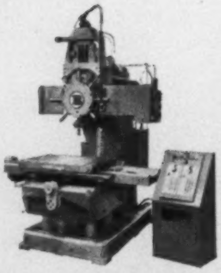
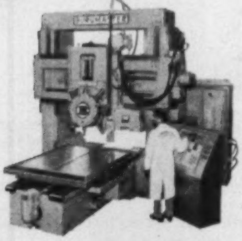
BURGMASTER MODEL 25AHT
6-spindle, 1¼" capacity in steel. Table travel 15 x 26, 20 x 30, 30 x 45



MODEL 2BHT
6-spindle, ¾" capacity in steel. Table travel 10 x 18, 15 x 26, 20 x 30.



MODEL 3BHT
8-spindle, 1½" capacity in steel. Table travel 20 x 30, 30 x 45.



MODEL 3BHT-B DOUBLE HOUSING, PLANER TYPE
8-spindle, 1½" capacity in steel. Table travel 48 x 60.

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Drilling Machines

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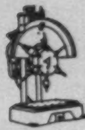
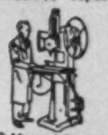
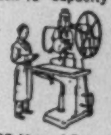
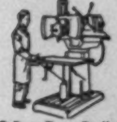
SAVE $40,000.00 IN SEVEN MONTHS

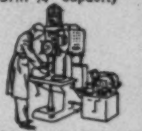
Convair(Astronautics) Division of General Dynamics Corporation, San Diego, California.

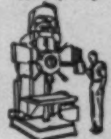

"O" Manual Power Index ¼" Capacity

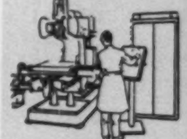

1C Manual Power Index ⅜" Capacity

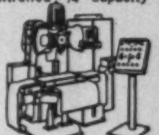

2B Manual Power Index ¾" Capacity


2BR Ram Type Radial Drill ¾" Capacity

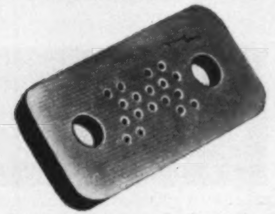

2BH Automatic Hydraulic ¾" Capacity

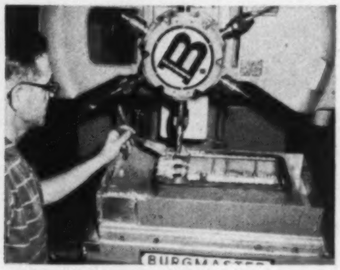

3BH Automatic Hydraulic 1½" Capacity


25AH Automatic Tape Controlled 1¼" Capacity


2BHT-3BHT Automatic Tape Controlled ¾" and 1½" Capacity

*200 Different Parts Programmed in Tape
*1000 Individual Items Without Rejection
*Downtime Less Than One Percent of Operation Time


Machining time of the above header board (1" x 2") has been reduced from four hours to 3 minutes by Convair-Astronautics use of a Burgmaster Tape Controlled Turret Drill.


Time of reaming, boring and tapping 90 holes in the above "abort sensor housing" by Convair-Astronautics has been cut from 32 hours to 4 hours by Burgmaster Tape Controlled Turret Drill.

CONVAIR ASTRONAUTICS has increased production, saved $40,000.00 in man/machine hours and eliminated rejections and scrap. In seven months of operation, approximately 200 different parts, and over 1,000 individual items have been worked on their two Burgmaster Model 2BHT-L Tape Controlled Turret Drills . . . with no rejections due to positional errors. Parts have been both ferrous and non-ferrous, both cast and forged.

Part size range from a tiny header board (1" x 2") with twenty holes center drilled, drilled and reamed to close tolerances. On one side of the board, the small holes are countersunk. Burgmaster Tape Controlled Turret Drills have reduced time on this part from 4 hours to 3 minutes.

To an (18" x 20") abort sensor housing with 90 holes of various sizes reamed, bored and tapped. Burgmaster Tape Controlled Turret Drills have cut the time on this part from 32 to 4 hours, or a man/machine savings per part of $300.00.

At Convair–Astronautics, Burgmaster Tape Controlled Turret Drills save many dollars in tool design, tool manufacture, and in the cost of re-work due to engineering changes.

Human element error is reduced appreciably resulting in further savings on inspection, rejections, scrap and lead time to get into production.

Burgmaster CORPORATION

15001 S. Figueroa Street, Gardena, California, FAculty 1-3510

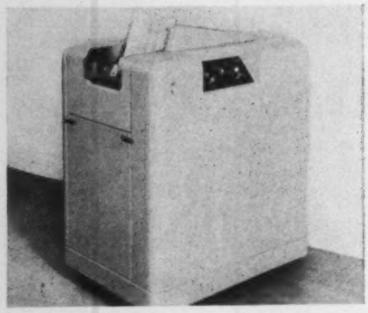
BURGMASTER DIRECT SALES OFFICES: Ridgewood, New Jersey, 86 North Maple Avenue., GIlbert 4-3002 • **Chicago 5, Illinois,** 4908 Lincoln Ave., LOng Beach 1-1178 • **Cleveland 7, Ohio,** 14706 Detroit Ave., ACademy 6-7030 • **Detroit 37, Michigan,** 13730 W. Eight Mile Road, LIncoln 8-4333 • **Northern California, Castro Valley,** JEfferson 7-1650 • **Kearney & Trecker, C.V.A. Ltd.,** Sole Agents for Great Britain, British Commonwealth and Western Europe.

BURGMASTER

SEND FOR LITERATURE

Write for bulletin describing Burgmaster 6 and 8 Spindle Tape Controlled Turret Drilling, Tapping and Boring Machines. Forty minute 16 mm sound film showing all Burgmaster Turret Drills in operation is available without charge from any office.

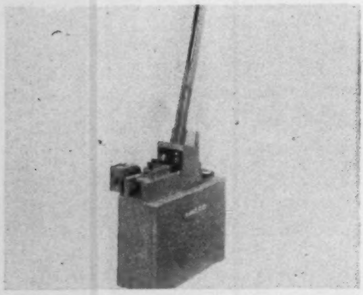
Circle 684 on Page 19



CARD READER FOR PROGRAMMED CONTROL SYSTEMS

Designed for use with card-programmed industrial control systems, the CR-201 card reader will transport IBM cards from a card hopper past two read stations and into a card stacker at a speed of 30 cards per minute. Scanning is independent of card feed. The card reader may be operated either from an integral control panel or by a remote automatic control system. Three modes of operation are available: Continuous scanning, automatic stop at any required row and continuous readout, and individual selection of any required row. Cards perforated in any binary or alphanumeric code will be accepted by the reader. **Datex Corp.**, 1307 S. Myrtle Ave., Monrovia, Calif.

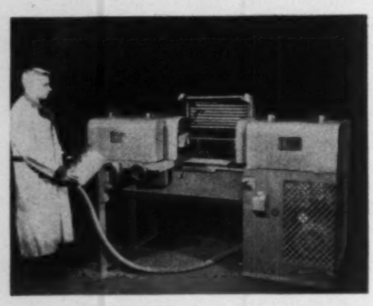
Circle 422 on Page 19



STACK HEIGHT SELECTOR SPEEDS LAMINATE STACKING OPERATION

Automatic stack height selector has been developed to reduce assembly time. It has speeded laminate stacking operation by 2½ times without sacrificing constant accuracy. This accuracy is maintained even while turning out over 500 stacks per hour. Lamination up to 4-inch diameter and height of stack up to 2 inches maximum can be handled by this selector, with preset stack height being measured within plus or minus one lamination. Other features of this machine include its acceptance of lamination even with excessive burrs and the ease of changeover for different sizes. **Automation Machines & Equipment Co. Inc.**, 3125 W. Mill Rd., Milwaukee 9, Wis.

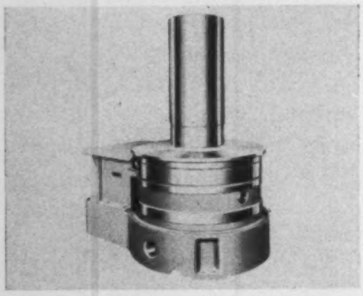
Circle 423 on Page 19



DOUBLE-END FINISHING MACHINE DESIGNED FOR HIGH PRODUCTION OF TUBING

Standard machine, especially designed for accurate, high-speed, simultaneous finishing of boths ends of tube, rod, and pipe, handles workpieces from ½ inch to 3 inches in diameter and up to 120 inches in length. Production rates of Model 666 range from 2400 to 3000 ends (1200 to 1500 finished parts) an hour. End-to-end tolerances are consistently held within 0.005 inch on a production basis. Workpieces are automatically fed into machining position by a hydraulically operated feed mechanism. Movable head is easily positioned on the machine for a specific length of workpiece. **Pines Engineering Co. Inc.**, 601 Walnut St., Aurora, Ill.

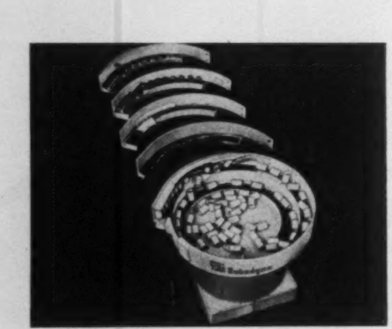
Circle 424 on Page 19



TURRET INDEXING MACHINE CHASSIS

Heavy-duty turret indexing chassis provides intermittent motion for multiple-station operations and a stationary center column for inboard tool mounting. The Series K chassis is a complete packaged mechanism including motor, drive, and clutch. Package is intended as a basic unit around which special automatic machines can be developed. It is available with 6 to 32 work stations and a wide variety of indexing speeds. Unit features an 18-inch diameter center post which makes it especially adaptable for automatic drilling, tapping, reaming, milling, processing, and assembly operations where the tools lend themselves to overhead center mounting. The chassis is normally furnished with a 43-inch diameter work-mounting plate, but larger diameter ribbed turrets may also be supplied. **Swanson-Erie Corp.**, 814 E. 8th St., Erie, Pa.

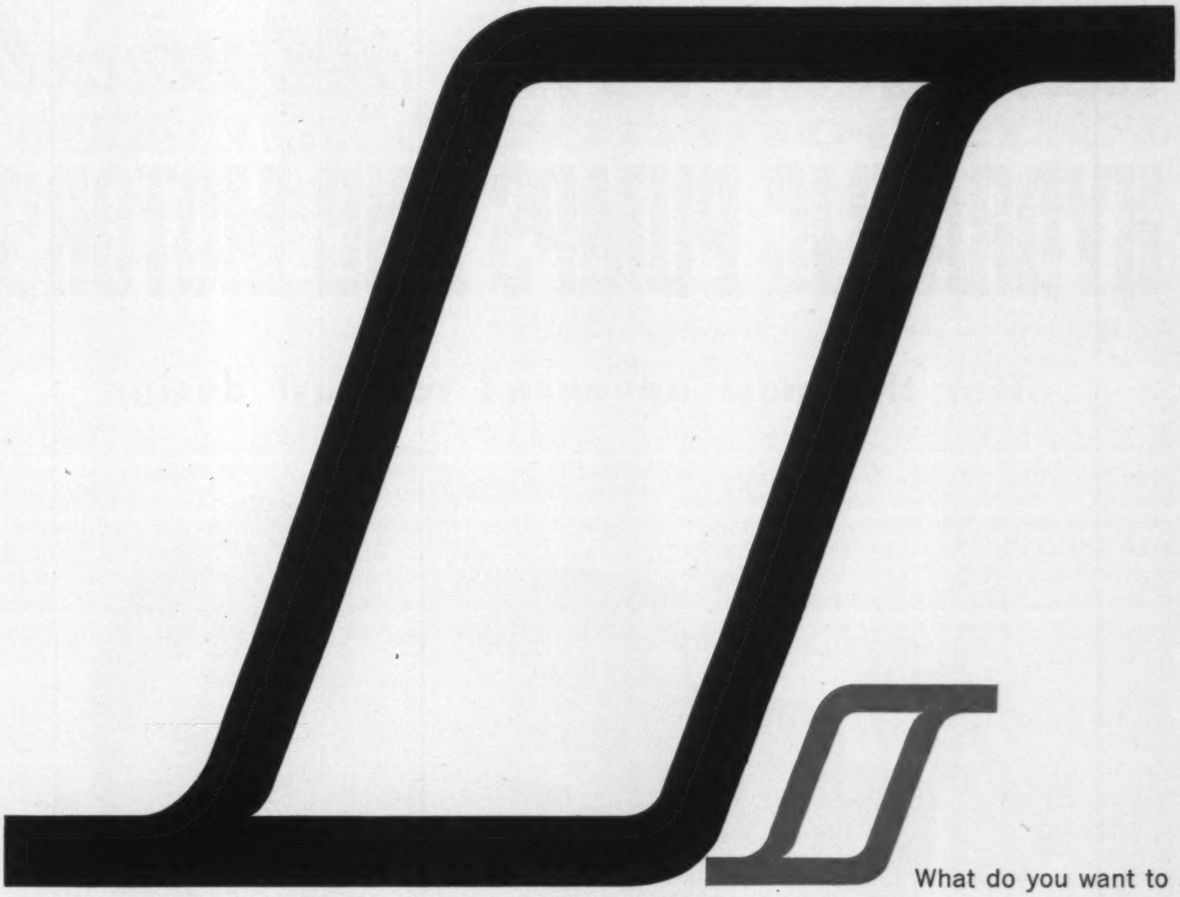
Circle 425 on Page 19



PARTS FEEDER FEATURES AN INTERCHANGEABLE PARTS ORIENTATION SEGMENT

Designated as TransferRobot, this parts feeder automatically feeds, orients, and dispenses a variety of small parts. Each feeder bowl is designed for fully interchangeable mounting of various orientation segments. The segment tooled to orient a particular part can be replaced quickly by another segment tooled for a different task. Five standard segment designs for each bowl size cover a range of orientation needs. The feeder is available in two sizes, 18 and 24-inch bowl size. The width and pitch of the track in each bowl have been selected to accommodate a wide range of part sizes and shapes. A control circuit provides smooth and positive amplitude control for the feeder. **USI Robodyne, Div., U. S. Industries Inc.**, 8411 Second Ave., Silver Spring, Md.

Circle 426 on Page 19



What do you want to control? The flow and measure of 20,000 amperes in an aluminum ore processing plant? (A large static control system will provide pinpoint control—and eliminate the need for direct connections between meter panel and bus bar.) Or do you want to supply exact change in an automatic bill-changer? (A small static control system will do this—and detect counterfeits to boot!) Large system or small, static control can be the answer. ■ We show large and small hysteresis loops to define these systems as *magnetic* static control. Such systems have no moving parts (static), and under normal operating conditions will never burn out or wear out. There is virtually no maintenance needed, almost no heat loss, and fewer components than in conventional systems. Static control systems are used on automobile assembly lines, for annunciator systems, and for controlling the speed of 1/20-hp motors. If you, too, would like to learn what your operating statistics and costs could be by using magnetic static control, write to Magnetics Inc., Dept. **A-87,** Butler, Pa.

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MAGNETICS inc.®

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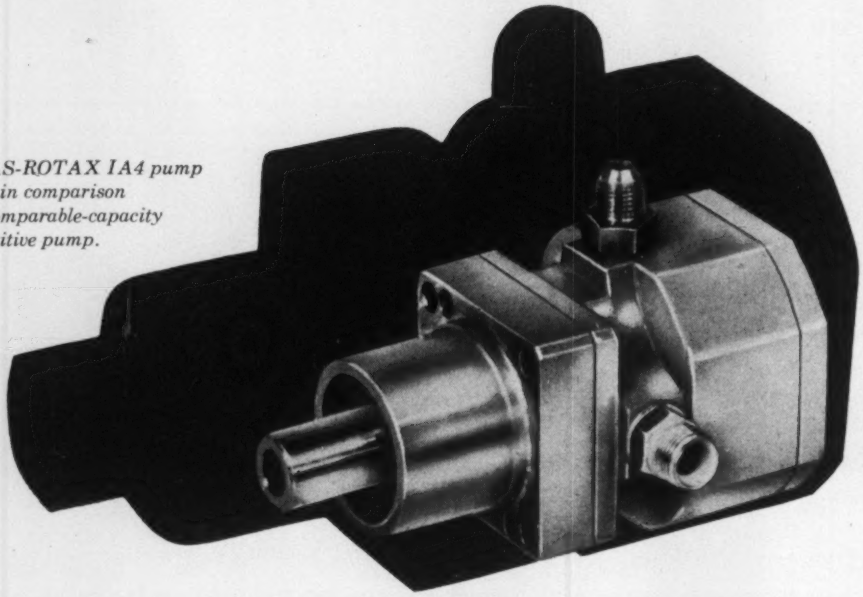
HYDRAULIC PUMPS AND MOTORS

offer the most advanced compact design



LUCAS-ROTAX IA4 pump shown in comparison with comparable-capacity competitive pump.

If you are interested in industrial hydraulic pumps or motors in the 1.5 to 108 g.p.m. range at pressures to 5000 p.s.i., you'll find more good design features in Lucas-Rotax pumps and motors than in any other quality line.

Lucas-Rotax industrial hydraulic pumps and motors are smaller and lighter than conventional units with low noise level in spite of high operating speeds. They offer fast response rate in pressure compensation and the low and medium capacity units can be operated from 2-pole motors to reduce the cost of the prime mover.

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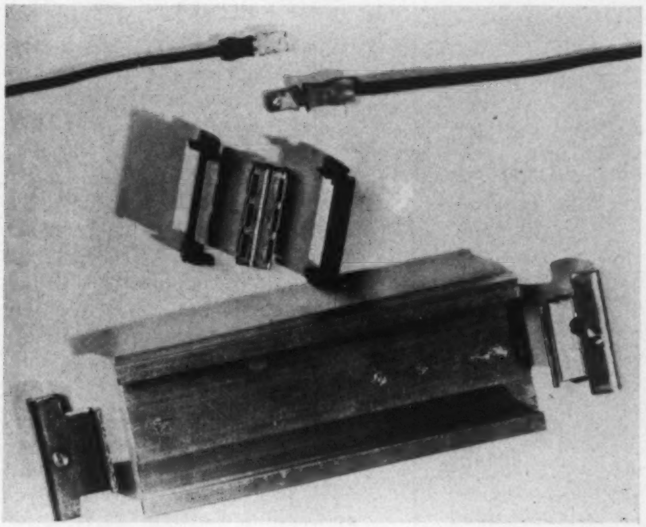
6004

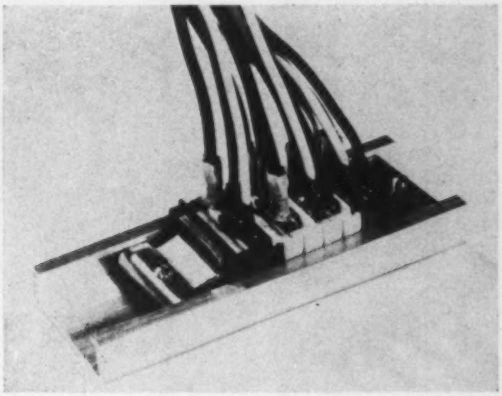
Circle 685 on Page 19

AUTOMATION new components

Parts, elements and devices designed for creating more automatic systems.
For detailed information and literature, use card page 19.



Modular 3-circuit common and 6-circuit common insulated cage assemblies that fit into an extruded aluminum track are the bases for new terminal panel wiring block. These cages are made of tinplated brass and are housed in nylon insulators. The insulators are available in 10 colors for color coding of circuits.



Because the cage assemblies are modular, stack configurations can readily be made to suit specific kinds and varieties of wiring logic. Individual cages can be added anywhere in the stack. This is accomplished by unlocking the end-locks (two per track length), turning the cage on an angle, inserting it under the track lips, and straightening the cage into position.

Modular Terminal Block

DESIGNATED Termi - Blok, module has been developed by **AMP INC.**, Eisenhower Bldg., Harrisburg 13, Pa., for use in electrical distribution applications.

Bases for the unit are either modular 3-circuit common or 6-circuit common insulated cage assemblies which fit into an extruded aluminum track. Cage assemblies are available in two series—Series 3 will accommodate three circuits per lineal inch of track, and Series 4 will accommodate four circuits per lineal track inch (one size of track will accept both series). Series 3 has a taller, thicker nylon insulator than Series 4 to permit an increased creepage distance of ⅝ inch minimum with a ¼-inch strike distance, for certain ultra-high amperage applications, or where heat dissipation is a prime requirement.

High density afforded by this cage design—0.257 center-to-center lineal spacing for Series 4 and 0.333 center-to-center lineal spacing for Series 3—is further complemented by the front-loading feature of the module. Within each of the modular cage assemblies is a slotted stainless steel spring member, either 3-circuit common or 6-circuit common. These commoned spring members accept terminals in two thicknesses without any adjustments of screws, nuts, bolts, springs, or washers. The tab terminals are terminated to circuit wires by a compression crimp which is accomplished with a contact-mated tool. The 0.031-inch thick tab terminal will accommodate wire sizes from 14-22 gage. Insertion forces for this tab range from 2 lb minimum to 15 lb maximum; withdrawal forces are from 5 lb minimum to 15 lb maximum. The 0.040-inch thick tab terminal accommodates wire sizes from 10-12 gage. Insertion forces for this tab range from 2 lb minimum to 15 lb maximum; withdrawal forces range from 10 lb minimum to 20 lb maximum. Two kinds of tab terminals are available, in either strip form or loose-piece form. The insulation on these pre-insulated terminals comes in three colors, coded by wire size.

Because the cage assemblies are modular, stack configurations can readily be made to suit specific

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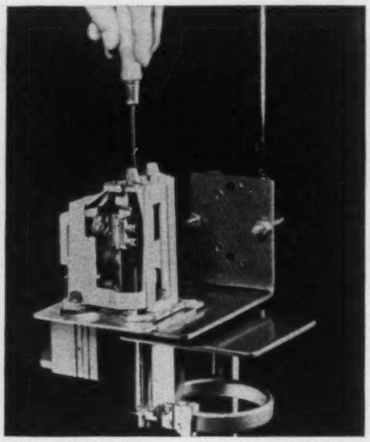
Circle 686 on Page 19

kinds and varieties of wiring logic. The extruded aluminum track comes in standard six-foot lengths and may be cut to any desired length.

Current rating of this new modular terminal block is 35 amp continuous current and maximum wire temperature of 105C. Voltage drop of the cage assembly, measured between the end terminals of a 3-way cage, is 4.5 millivolts maximum drop for a three-way cage at 22 amp, and 5 millivolts maximum drop for a six-way cage at 22 amp. Current cycling overload capacity is 125 per cent, and insulation resistance is 1500 v dc at sea level. Vibration is rated at 10-55 cycles per second according to MIL-T-7928C. Corrosion resistance and humidity resistance tests indicate compliance with MIL-T-7928C on a 3-way cage.

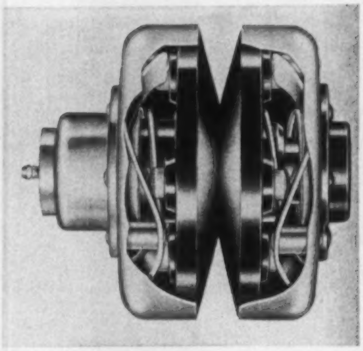
Circle 427 on Page 19



Pressure Transmitter

Force balance pressure transmitter provides 1 to 10 span suppression for accurate measurement of small pressure increments. It consists of a force balance mechanism driven by a Bourdon tube. Available in 5 pressure ranges up to 7500 psig, the pressure transmitter is capable of expanding a small pressure increment to cover the full signal range for accurate measurement or control. All pressure measurements are transmitted over standard SAMA signal range of 3 to 15 or 3 to 27 psig. **Bailey Meter Co.,** 1050 Ivanhoe Rd., Cleveland 10, Ohio.

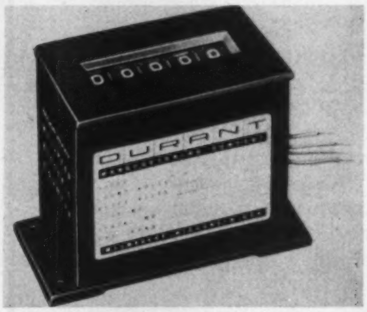
Circle 428 on Page 19



V-Belt Pulleys

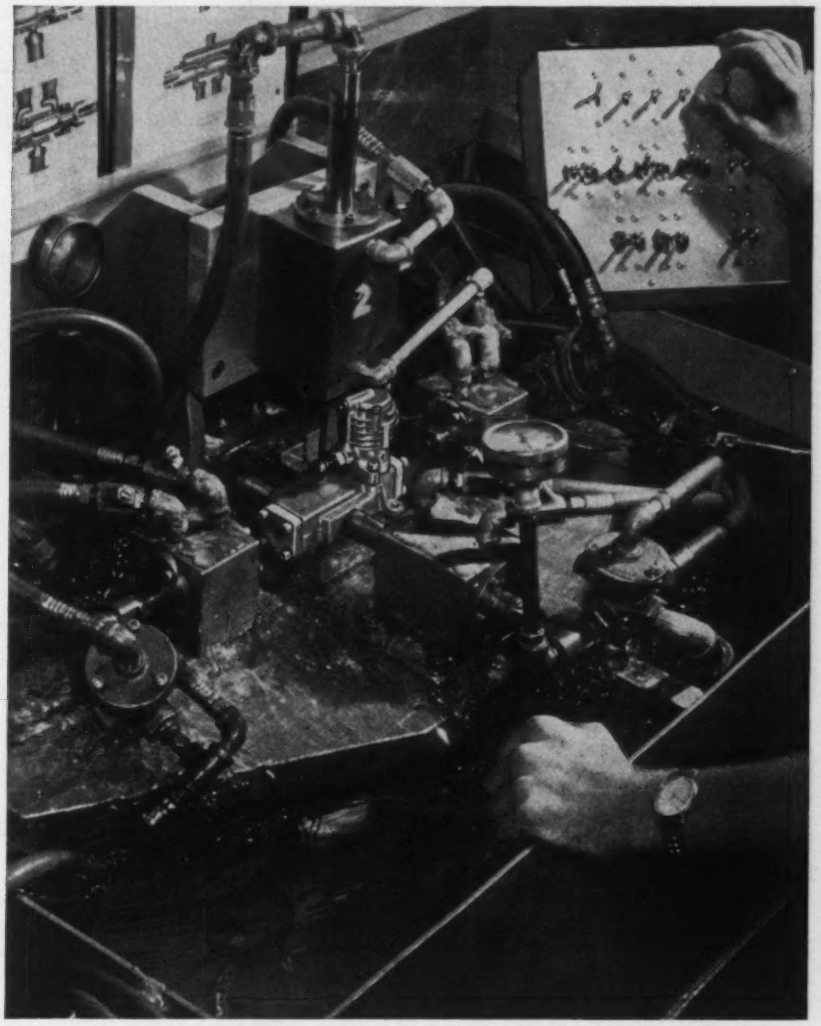
Wide V-belt pulleys feature cam control design developed to assure greater variable speed efficiency. They are rated at 1 to 5 hp at 1750 rpm and provide instantly variable ratios up to 3 to 1. Available models are: 1060, 1160, 1280, 1390, and 1590. Depending on the model, the pulleys use No. 087, 12 or 14 top width variable speed belts. Standard bore sizes are from 5/8 to 1 1/8 inches and keyways 3/16 by 3/32 inch and 1/4 by 1/8 inch. Bore lengths are 2 1/2 to 3 5/8 inches; maximum pitch diameters 5.78 to 8.62 inches; minimum pitch diameter 1.875 to 2.87 inches. Motor travel is 3 1/8 to 4 inches. **Lovejoy Flexible Coupling Co.,** 4884-H W. Lake St., Chicago 44, Ill.

Circle 429 on Page 19



Electric Counter

Device, designated YE Series electric counter, can be instantly reset to zero, either electrically or with a flick of the finger, and can count up to 1500 counts per minute. It is widely used with electric computers, card and check sorters, coin counters, electronic sealers, photoelectric and remote control counting instruments, and for light production



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Valvair does! How else can any manufacturer be sure that every valve he ships to a customer will function properly, from the first cycle on?

Each Valvair valve is cycled and re-cycled under water, at 30 to 50% above its rated pressure, to be certain that it meets Valvair's rigorous performance specifications. And, this final operating test is just one of the countless rigid quality control inspections each part of every valve must pass during its manufacture. In fact, one out of every twelve Valvair production men is a full-time inspector. Parts are scrutinized in process, as well as just prior to assembly. The most modern types of equipment, including optical comparators, surface finish indicators, optical and air gaging units, super magnifiers and precision gages, are used by the inspection team to assure Valvair's reputation for outstanding quality.

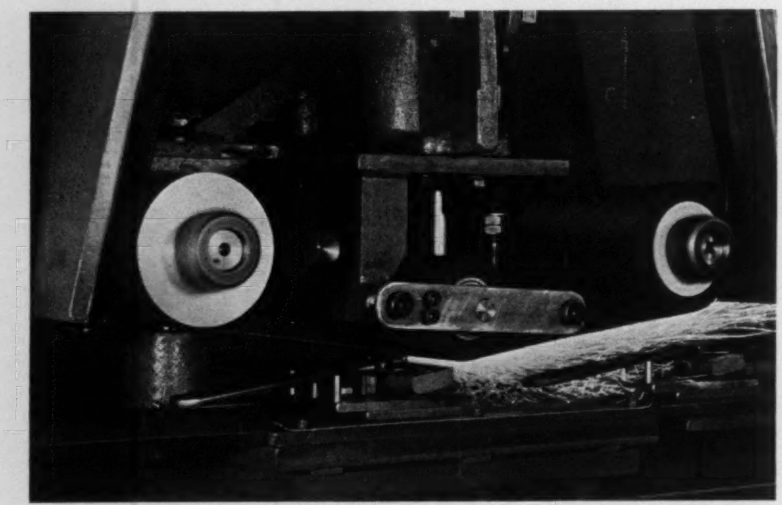
Specify Valvair components for the equipment you design, build or operate, to maintain your reputation for quality. For all the facts, write for Bulletin 59-SK, or call your nearby Bellows-Valvair Field Office. Address Bellows-Valvair, Akron 9, Ohio, Dept. AU-761.

Bellows-Valvair
AKRON 9, OHIO
DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION (IBEC)

8171

Circle 687 on Page 19

ACME IN ACTION



Progressive Finishing—Flat broached forgings ground, polished and buffed on an Acme Automatic Multiple-Head Machine.

Doing more work with
Movement and Motion

Designing and building versatile finishing machines that do more work—better, faster, easier, and at lower cost—is a specialty at Acme. Has been, too, for over half a century.

Take the multiple-head flat surface finishing machine shown close-up in action above. It consists of standard Acme components, yet it can be used to perform a number of operations on a wide variety of parts. Deburr, grind, polish—buff or satin finish. All done automatically—in a single pass if desired. What's more, oscillating movement of the conveyor in motion prolongs useful life of abrasive belts and buffing wheels—assures greater uniformity of finish on every piece.

Range of models? Light and heavy duty machines—conveyor belt or pinch roll fed—available in sizes to accommodate your flat parts and products up to 74 inches in width!

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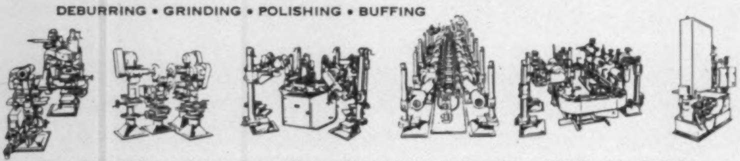

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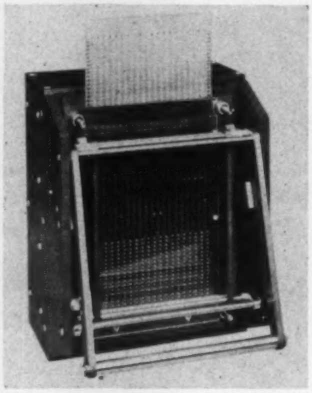
Circle 688 on Page 19

machines. There are four available models, base mounting or panel mounting, with pushbutton instant reset or instant electric reset. Unit counts accurately at high, low, or intermediate speeds as conditions demand. Large 3/16-inch high white figures stand out clearly on black background. **Durant Manufacturing Co.**, 1997-IS N. Buffum St., Milwaukee 1, Wis.

Circle 430 on Page 19



Punched Card Switch

Model K-1000 provides 1000 switches operable from a card of 20 rows by 50 columns. There is a separate switch for each hole position. After the card is inserted and the operating lever is pushed, punched holes have closed switches, unpunched holes have open switches. The switch lends itself to automatic control of machinery where patch board programming has been found inefficient. Reliability of the switch is attributed to gold plating used over the silver plating of the contacts. **Taurus Corp.**, Academy Hill, Lambertville, N. J.

Circle 431 on Page 19

Remote Control Valves

Automatic opening, closing, and timing of pipe lines is made possible with this line of remote control valves. Used in conjunction with a simple cam switch, timing switch, or sequence timer, these valves eliminate human error in scheduling the flow of water or other liquids. Typical applications include water conditioning systems, coolant systems, filtration

Now...
Sylvania cuts the price of automation

New, compact 44-station automatic transfer machine brings the benefits of automation within reach of most manufacturers.

It's about half the size of other top-quality transfer machines, far less expensive, too. What's more, it dovetails neatly into the trend to smaller and smaller products and assemblies by providing more stations per foot.

It's a machine that could be ideal for you if you make any product that involves several station-to-station operations.

WHAT IS A TRANSFER MACHINE?

It's automation's basic building block. It moves pieces-in-production from one tool or worker to another, stops the piece long enough so it can be bent, drilled, tapped, heated, measured, molded, riveted, coated, assembled, packaged, etc.

Sylvania makes several models of these basic machines. And if you do not have facilities, we can recommend reliable and experienced manufacturers of the necessary tools, jigs, etc., which you'll need in your automation program.

HOW TO AUTOMATE

That's a tough one. It varies almost with each manufacturing operation. Sylvania will provide free consultation to help with your particular problem but, in any event, there's one basic rule for almost every situation: *You must start with the best transfer machines if you're going to realize the full benefits of automation.*

Naturally, you pay more for the best. But a good transfer machine can last for 30 years or more. What's more, by changing tools and jigs, it can be adapted to almost any conceivable production operation. You can even change products without changing transfer machines.

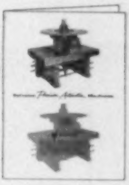
WHERE TO BUY

Naturally, we're a bit biased, but we believe Sylvania transfer machines are the best on the market.

We've been building them for our own use for over 20 years, because we have never been able to buy one that met our accuracy standards for the manufacture of lamps, tubes, fine electronics equipment.

We make two general types—Rotary indexing chassis and Conveyor indexing chassis. Both have many exclusive features which contribute to their outstanding performance. And we also make 5 models of precision indexing transmissions of superior quality.

FREE HELP—AND INFORMATION. If you're thinking of automating, we'd be glad to have one of our automation sales engineers call on you with his suggestions and advice. Or, if you'd like more details on Sylvania transfer machines, send for our free brochure.



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Equipment Development Plant
121 Loring Avenue, Salem, Mass.

Please send me free brochure of:

☐ Rotary ☐ 44-Station Conveyor and 80-Station Conveyor ☐ Transmissions

Name____________________________

Position ____________________________

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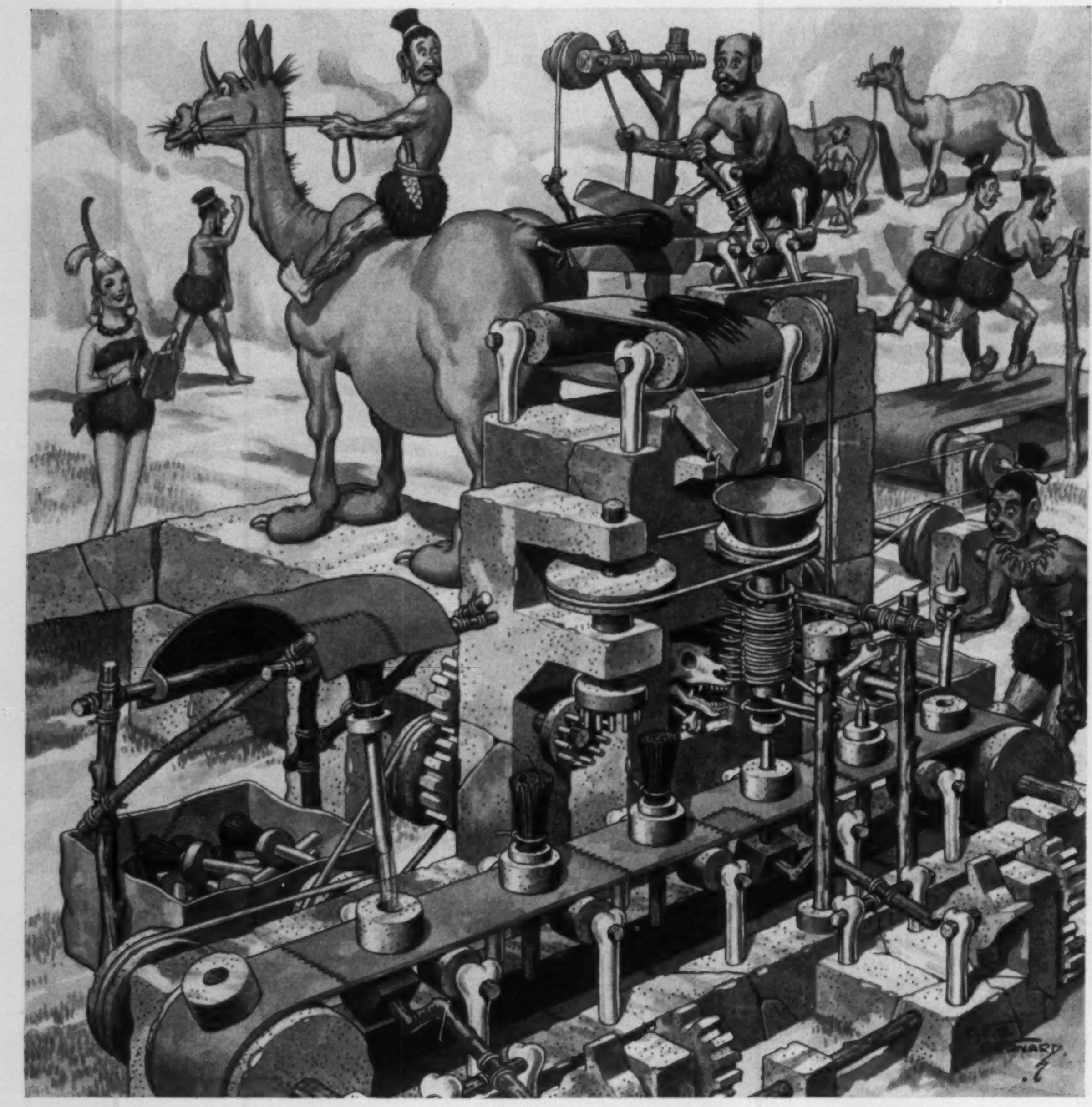
GENERAL TELEPHONE & ELECTRONICS

GENERAL SYSTEM

Circle 689 on Page 19



The result of one of man's earliest brushes with automation, this Automated Brush Maker of 333,333 B.C. (or thereabouts) was positively bristling with advanced ideas for making every brush job a rush job.

GREAT MACHINES OF WESTERN MAN

This backward look at the backward days of automation is lovingly dedicated to industry everywhere by Barkley and Dexter with this reminder: that industry anywhere can progress and profit from the forward looking services of B & D, one of the nation's foremost specialists in industrial mechanization and automation.

You should know more about B & D. Here is what our service consists of:

PLANNING — we determine if mechanization can help you; where it can help you; how it can help you; how much it is likely to cost; how much it will save.

DESIGN, DEVELOPMENT, PRODUCTION — working with your personnel, or independently, we custom design, develop and build automatic equipment and controls to replace hand labor or perform new operations.

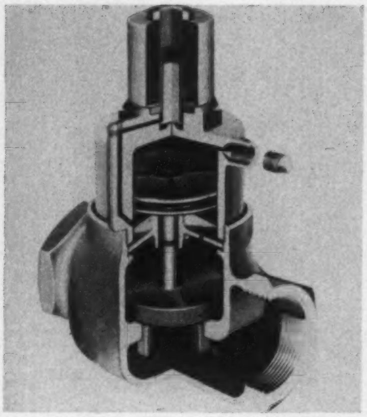
TROUBLE SHOOTING — our long experience can help you eliminate bugs from your own production lines.

For further information, send for the folder on our services. Or better still, write us about your problem.

BARKLEY & DEXTER INCORPORATED

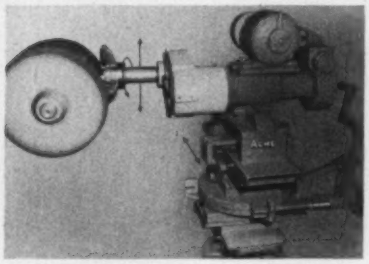
50 FRANKFORT STREET, FITCHBURG, MASSACHUSETTS—*Pioneers in Automation*

Circle 690 on Page 19



plants, altitude valves, and food, pharmaceutical, and chemical processes. Rated for 150 psi water at 150 F, the valves are available for 1 through 6 in. pipe. Model 1825 valves incorporate a solenoid and are connected by wiring to the timing device. Model 25 valves are hydraulically actuated through plastic or copper tubing which links them with a hydraulic controller. **Febco Inc.**, 1993 Blake Ave., Los Angeles 39, Calif.

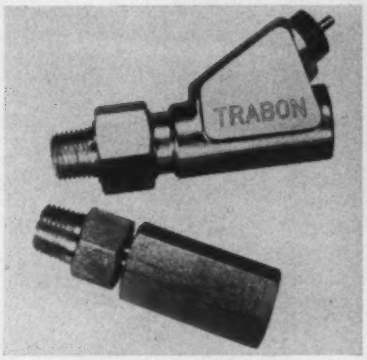
Circle 432 on Page 19



Oscillating Attachment

Vertical oscillating attachment that can be easily installed on a line of semiautomatic buffing machines permits mush or slough buffing type finishing operations on recessed and contoured type parts. It permits separate buffing operations to be combined into one operation thus providing an economical means increasing the versatility and flexibility of single spindle semiautomatic workholding machines. This attachment is ideal for the finishing of such parts as: Deep irregularly shaped die castings, hub cap wheel spinners, horn rings, faucets, bath tub spouts, drill motors, and emblems having deep impressions, contours, and recesses. Maximum vertical stroke is 6 inches and is adjustable to meet specific finishing applications. The attachment is driven by an eccentric gear mechanism and can be used with vacuum chucking arrangements. **Acme Mfg. Co.**, 1400 E. Nine Mile Rd., Detroit 20, Mich.

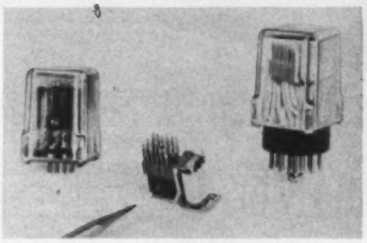
Circle 433 on Page 19



Broken Line Indicators

Hydraulic broken line indicators are designed for use with Type M and MX grease and oil systems and Type MO and MXO circulating oil systems. They provide central warning at the pump plus visual pin indication at bearing line outlet. Two sizes are available: The BLM kit including indicator, check valve, and simulator for M and MO systems, and the BLX kit for MX and MXO systems. Indicator spring pressures are available to meet system pressure conditions ranging from 400 psi for circulating oil to 1200 psi for large grease systems. **Trabon Engineering Corp.**, 28815 Aurora Rd., Solon 39, Ohio.

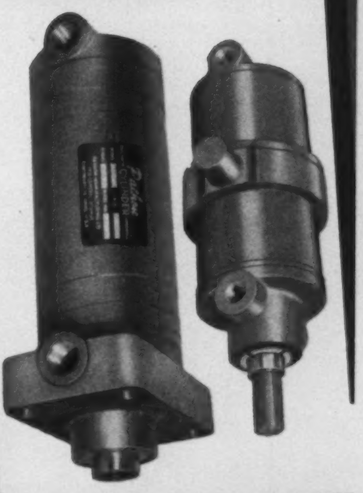
Circle 434 on Page 19



Cradle Relays

Cradle relays up to 6PDT feature plug-in mountings. Type TA, center of photograph, is available either hermetically sealed or with flame resistant polycarbonate dust

Pathon
Cylinders
are
most ✓
DEPENDABLE
because

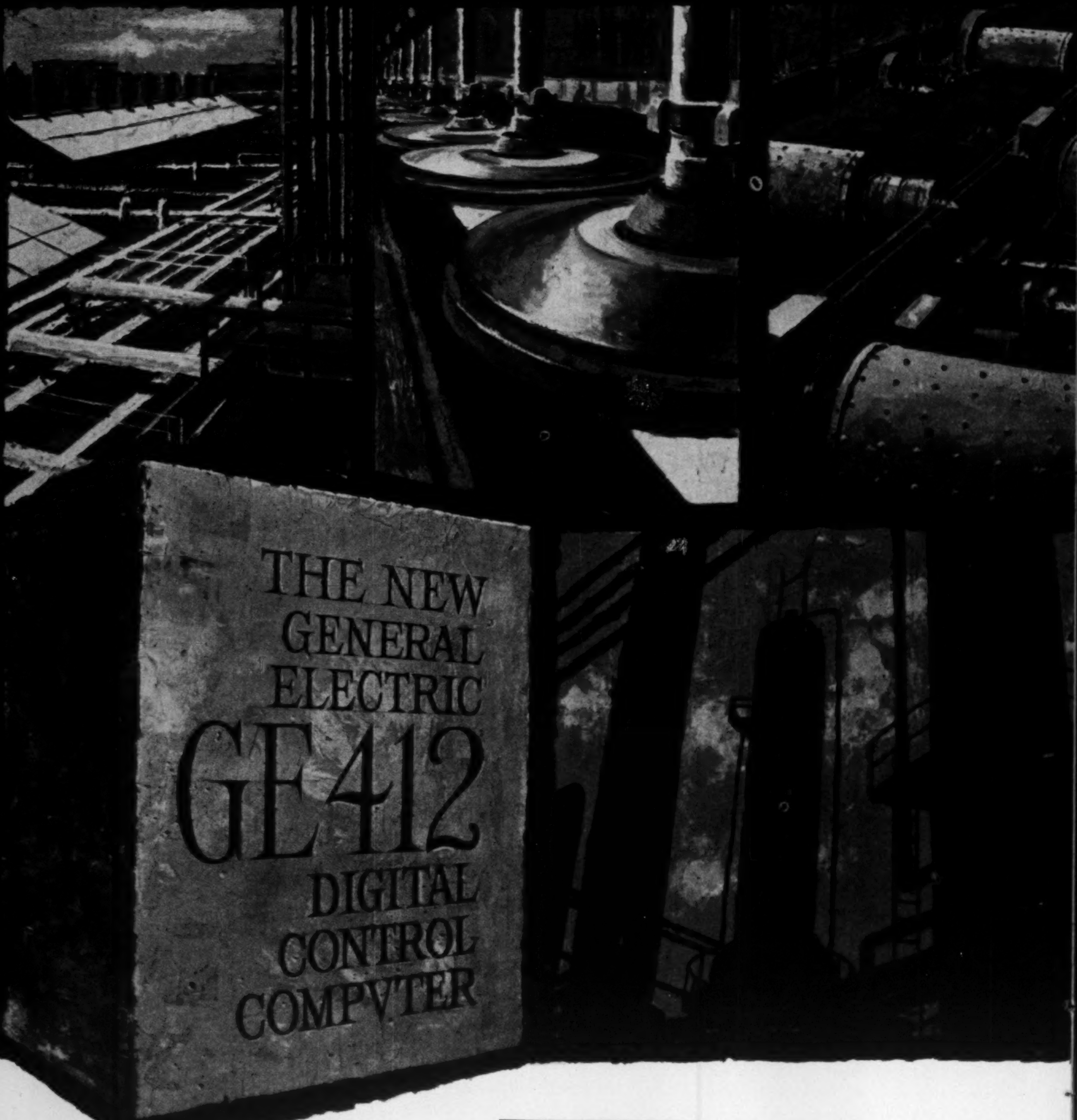


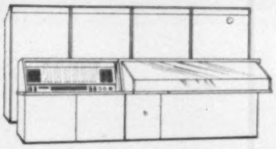
1. Screw thread heads to barrel attaching method gives maximum strength and requires minimum mounting area.
2. All mounting pads are integrally cast, and precision machined to assure greatest rigidity and perfect alignment.
3. Rod bearings, which are inboard of packing and pressure lubricated, provide longest possible service life.
4. Any wearing part can be replaced quickly, without complete disassembly.

Learn how dependable cylinders can be. Specify Pathon. A complete line of cylinders from 200 to 3000 P.S.I. Write for Catalog.

Pathon
MANUFACTURING COMPANY
3823 Pacific Avenue Cincinnati 12, Ohio

Circle 691 on Page 19


THE NEW
GENERAL
ELECTRIC
GE 412
DIGITAL
CONTROL
COMPVTER



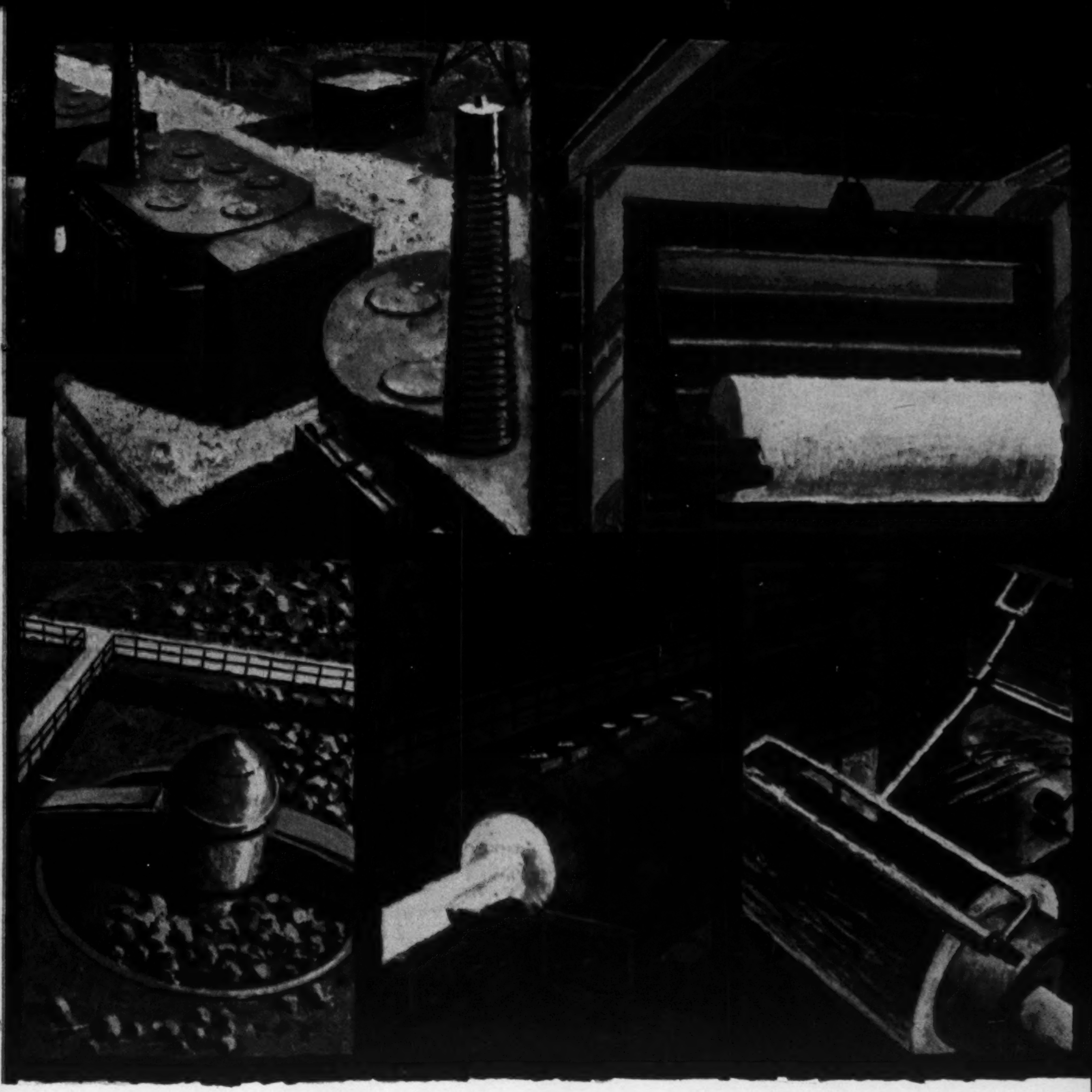
CORNERSTONE
FOR YOUR AUTOMATION PROGRAM

CHEMICALS • ORE REDUCTION
PETROLEUM REFINING • PAPER • GLASS
CEMENT • ALUMINUM • UTILITIES • STEEL

General Electric announces the new GE 412, a second generation solid-state, stored program computer designed solely for industrial and utility applications.

The GE 412 Digital Control Computer, new "big brother" in the General Electric family of process computers, has been designed with the total systems concept and flexibility of equipment organization in mind.

PCA-2



The resultant versatility and capability of the GE 412 makes it custom-adaptable to many particular applications in many varied industries—data-logging and monitoring, data-logging and control, economic dispatching, director (or dispatcher) in a multi-control system.

The new GE 412 is extremely fast—capable of 25,000 additions a second. It incorporates a core memory with drum memory backup, plus more than 100 basic commands, to provide wide programming flexibility. The Automatic Program Interrupt feature and Programmable Elapsed Time Counters permit the regular survey of critical points without wasting valuable computer time required for constant checking.

General Electric offers you the two basic elements for your automation program—the new GE 412 Digital Control Computer and the application experience necessary to get it operating efficiently in your plant.

General Electric engineers can detail the available full line of input/output equipment and computer services including SYSTEM DESIGN, PROGRAMMING and AIDS, TRAINING, INSTALLATION SERVICES, and MAINTENANCE SERVICES—offered by General Electric to get your automation program in operation quickly . . . for lower production costs, increased profits.

INVESTIGATE THE NEW GE 412—*contact your nearest General Electric Apparatus Sales Office or the Process Computer Section, Industry Control Department, P.O. Box 2918, Phoenix, Arizona.*
IN CANADA, *contact Canadian General Electric Apparatus Sales Department, Peterborough, Ontario.*
OUTSIDE THE U. S. AND CANADA, *contact International General Electric, 150 East 42nd Street, New York 17, New York.*

Progress Is Our Most Important Product

GENERAL ELECTRIC

Circle 692 on Page 19

AIR-HYDRAULICS INCORPORATED

DOUBLE ACTING • ADJUSTABLE AIR PRESSES

PRECISION HONED WITH CUSHIONED CYLINDERS
TWO FAST ACTING MODELS

For fast and steady small assembly work • riveting • punching • marking • staking. Equalized ram pressure in excess of 1 ton and ½ ton from 90 pound line. Double action gives lifting power almost matching ram pressure. Maintenance reduced by using "O" ring seals and bronze ram bushings. Head fully adjusts for proper stroke length and accurate die-setting. Extra heavy ram guide.

FOR LOW COST APPLICATION TO YOUR JOB — WRITE

AIR-HYDRAULICS INCORPORATED

CUSHIONED STOP . . . FOR *ACCURATE* INDEX

AIR CYLINDER CUSHION CONTROL
AIR SPEED CONTROL

HERE'S YOUR ANSWER, if accuracy and dependability are important to you. Cushioned stop eases work to position. Locking cylinder stops the table "on the money" and holds it until released by locking dog. Changes in loads, diameters or speeds are no problem either, since both speed and cushion are adjustable. Top plate is 15" in diameter but the rugged mechanism will handle much larger work loads. Table will make up to 100 indexes per minute with a 22" diameter, 200 lb. load.

OPERATES on 60-175 lbs. pressure when equipped for air but table is available for either air or hydraulic operation. 4, 6, 8, or 12 stations are standard but others, up to 30, are made to order.

REPRESENTATIVES:
SOME TERRITORIES STILL OPEN.
WRITE FOR INFORMATION.

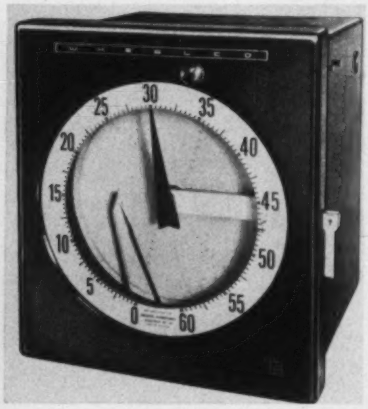
AIR-HYDRAULICS INCORPORATED

299 HUPP AVENUE
JACKSON, MICHIGAN

Circle 693 on Page 19

covers. New plug-in mountings mate with commercial 20-pin miniature sockets (Type TADO, right). Contact rating, 2 amp resistive, 1 amp inductive at 29 v dc or 115 v ac. A 14-pin plug-in up to 4PDT (Type TADG, left) mates with commercial sockets in combinations of 7, 9, 11, or 14 pins. Specifications: Shock resistance, 15g operational; vibration, 10-55 cps at 0.062-inch double amplitude; nominal coil power, 1.3 w; minimum operate power—50 mw, SP; 100 mw, DP; 175 mw, 4P. Low level or 5-amp contact available on request. **Allied Control Co. Inc.**, 2 E. End Ave., New York 21, N. Y.

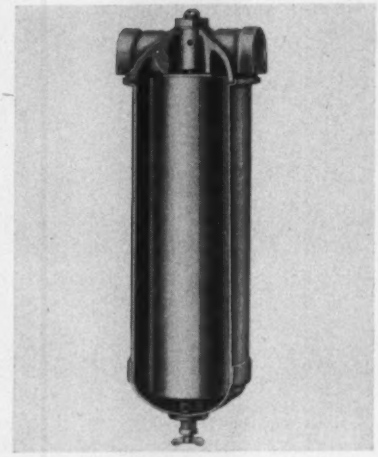
Circle 435 on Page 19



Indicating Controllers

Line of round chart recording and indicating controllers, designated Double-O, are completely self-contained, null-balancing instruments requiring only external sensing devices. A wide range of models are available for the measurement, indication, control, and permanent recording of temperatures. With proper circuitry and use of transducers, such variables as speed, strain, hydrogen ion (pH), and other quantities which can be resolved into electrical signals can be recorded and controlled. Line gives ½ of 1 per cent accuracy for all scale spans in pyrometric range. All thermocouple and radiation pyrometer ranges down to 5 mv full scale are available. Full-scale balance speed is 4 seconds. Full-size 12-inch chart has calibrated width of 4⅝ inches. **Wheelco Industrial Instruments Div., Barber-Colman Co.**, Rockford, Ill.

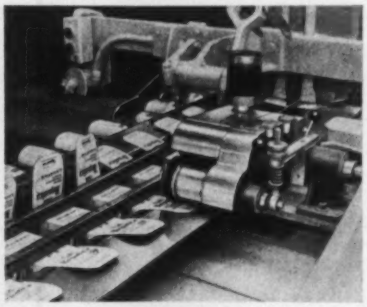
Circle 436 on Page 19



Metal Filter Element

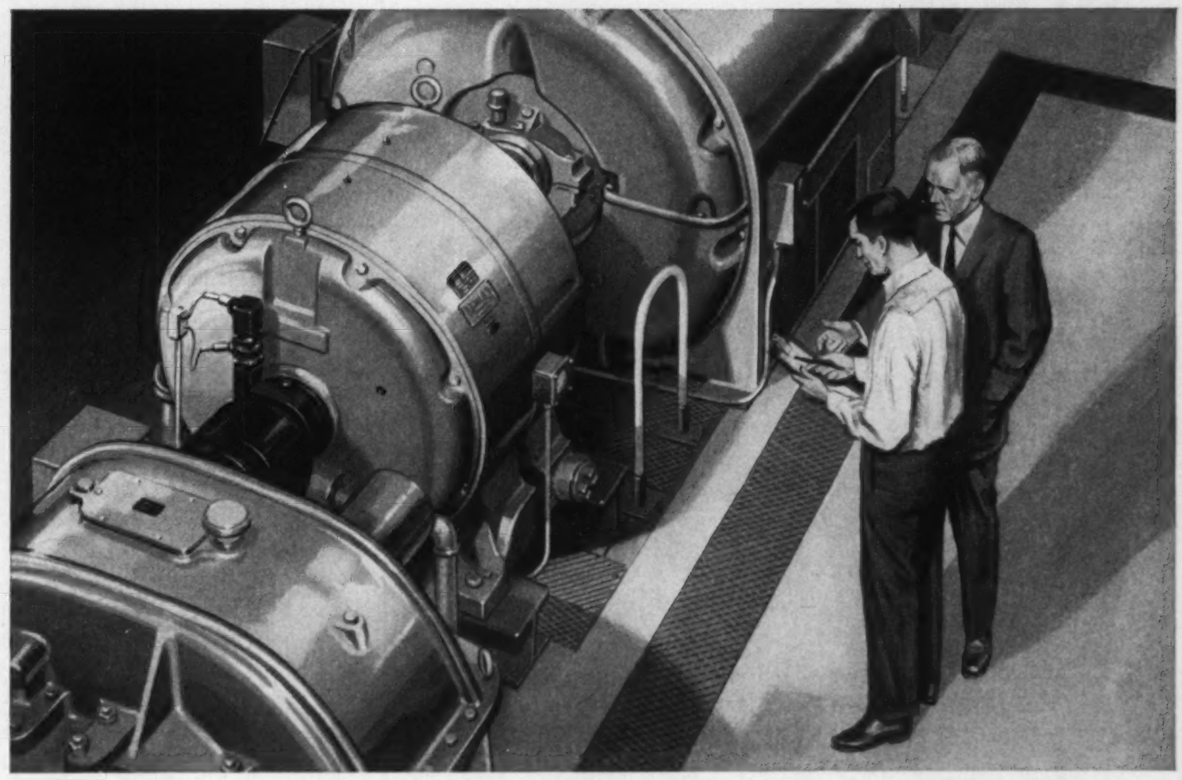
Porous metal filter element has been designed for filtration of corrosive, high temperature, and high viscosity fluids. It is adaptable to any of a line of Fulflo filters and is available in 40, 20, 10, 5, and 2-micron particle-retention ratings. This sintered 316 stainless steel filter element is free from media migration under high differential pressures, vibration, or thermal shock. **Commercial Filters Corp.**, 2 Main St., Melrose 76, Mass.

Circle 437 on Page 19



Carton Imprinter

Cartoning machine attachment imprints control numbers, codes, prices, varieties, etc., on the bodies or flaps of folding cartons. Designed specifically for attachment to popular makes of automatic cartoners, the imprinter is made in two basic styles. The 1270 applies the imprint from above, and the 1280 from below. Full annular registration simplifies the precise placement of imprints in any desired location, and interchangeable diewheels facilitate changeover from one imprint legend to another. Special



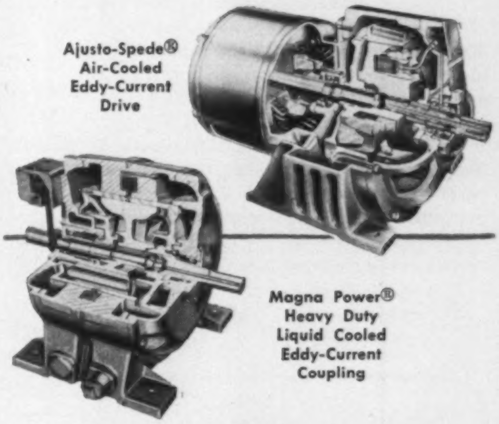
Place Your Speed Control Problems in the Hands of Experts!

As the originator and leading producer of eddy-current speed control equipment, it is only natural that Eaton-Dynamatic offers many exclusive design and construction advancements —plus expert engineering service.

The transmission of torque across an air gap by means of eddy-currents is a fundamental Dynamatic development. It was first utilized 30 years ago, and is today the operating principle of a full line of couplings, brakes, drives, and dynamometers serving industry wherever accurate control of speed and torque is required.

Eddy-current equipment runs on standard AC—requires no special power source. Electronic or transistorized magnetic amplifier controls, engineered and manufactured by Eaton, provide constant speed, infinitely adjustable speeds, and many specialized operating functions.

Representatives, located in all principal cities, are fully qualified to give you expert help with your speed control or torque transmission problems. Call the Eaton-Dynamatic representative nearest you today—there's no obligation.



Ajusto-Spede® Air-Cooled Eddy-Current Drive

Magna Power® Heavy Duty Liquid Cooled Eddy-Current Coupling

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Circle 694 on Page 19

NEW!
HIGH-SPEED,
SOLID-STATE,
PRESET COUNTER

MACHINING AND
PROCESS CONTROL
COUNTING
BATCHING
SORTING
MIXING
WINDING
PACKAGING
...or any other
physical process
that can be
electrically
digitized.

MODEL
300T

The completely transistorized Model 300T industrial counter is rugged, dependable and low-cost control instrumentation that is ideal for every use requiring a preset counting device. Modular design minimizes maintenance time and steel construction permits mounting directly on controlled machine. Modules can be easily modified for special applications. The 300T is a truly remarkable instrument that deserves your serious consideration.

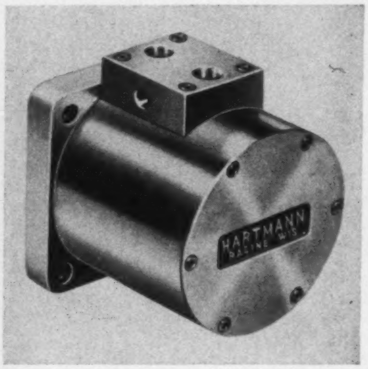
Send today for complete technical information.

SPECIFICATIONS
Speed: 6,000,000 counts per minute
Range: 1 to 9,999 standard.
5 to 8 decades available
Reset: Automatic, manual, local or external
Size: 3½″ high; 9½″ wide; 14″ deep (standard model)
Weight: Approx. 10 lbs.

ERIE
INSTRU/MATION
ERIE PACIFIC DIVISION • ERIE RESISTOR CORPORATION
12932 S. Weber Way, Hawthorne, California
Phone: ORegon 8-5418
Circle 695 on Page 19

mountings are supplied with the imprinter. **Adolph Gottsco Inc.,** Hillside 5, N. J.

Circle 438 on Page 19



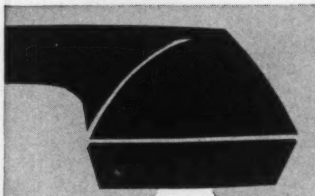
Hydraulic Motor

Rotating vane type hydraulic motor, designated Rol-Vane, is designed particularly for precision machine tools and equipment. It features smooth, pulseless, noiseless operation even at extremely low speeds; provides practically 100 per cent torque at stall; and infinitely variable speed. This completely self-contained unit can be connected directly to load. Three standard sizes are available. Displacements range from 2.2 to 7.6 cubic inches per revolution; torque of 35 to 121 lb-in. per 100 psi; hp output from 15 to 41.5. Motor is capable of speeds up to 1500 rpm and pressures to 2000 psi. **Hartmann Mfg. Co.,** 1637 Goold St., Racine, Wis.

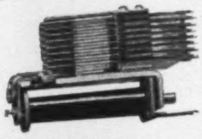
Circle 439 on Page 19

Digital Voltmeter

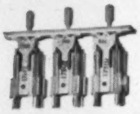
Series 5000 transistorized digital voltmeter features very high input impedance that does not depend upon a null condition within the instrument. This full-time high



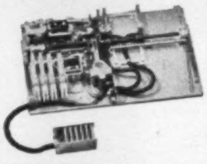
WHEN QUALITY
IS A MUST
Stromberg-Carlson®
TELEPHONE-TYPE
COMPONENTS



RELAYS: Wide range, for electro-mechanical switching. Send for Bulletin T-5000R2.



KEYS: Cam-type and push-button. Send for Bulletin T-5002R.



STEPPING SWITCHES. Fast and dependable. Bulletin T-5001R.

JACKS & PLUGS: For many electrical and electronic uses. Send for Bulletin T-5003.

TELEPHONE HANDSETS: Standard or with switch assemblies. Send for Bulletin T-5005.

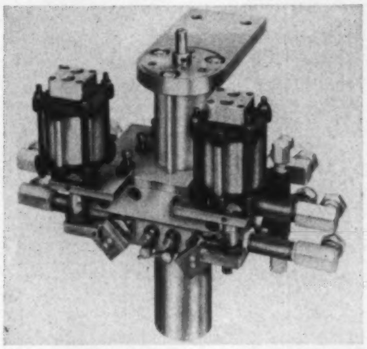
For bulletins and more information contact the nearest Sales Branch office: Atlanta—750 Ponce de Leon Place N.E.; Chicago—564 W. Adams Street; Kansas City (Mo.)—2017 Grand Avenue; Rochester—1040 University Avenue; San Francisco—1805 Rollins Road.

GENERAL DYNAMICS
/ELECTRONICS

Circle 728 on Page 19

input impedance prevents excessive loading of critical circuits when the instrument probe is first applied. An average of 200 readings per second is achieved with a ±0.01 per cent accuracy relative to either an external reference or the precise internal zener reference. A high brilliance in-line, in-plane projection readout is used to display four-digit reading, decimal point, and sign. Instrument provides decimal and binary coded decimal electrical outputs for driving a variety of accessories. **Electronic Associates Inc.**, Long Branch, N. J.

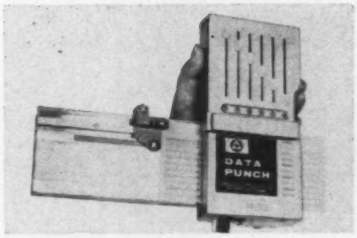
Circle 440 on Page 19



Foam Mixing Heads

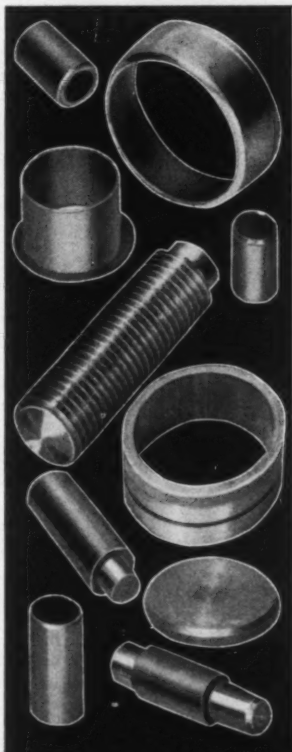
Up to six separate foam material streams, such as polyurethane, can be valved into the mixing chamber of this mixing head for on-off operation. The head is nominally rated at 100 lb per minute and makes possible the pouring of large foam masses on shot-type, production installations. With proper pumping and metering equipment, this mixing head will supply accurately proportioned and correctly mixed foam from the first to the last of the pour. This is accomplished by means of fast-acting valving; interchangeable metering port design; and a self-cleaning, straight-side mixing impeller. Other features include versatility of dual-valving on six-component designs and two extra ports into the mixing chamber furnished on all models. Many formulations can be mixed at rates in excess of 150 lb per minute for molding, pouring-in-place, or slab production of rigid and flexible foams. **Martin Sweets Co. Inc.**, 114 S. First St., Louisville 2, Ky.

Circle 441 on Page 19



Data Punch

Compact, portable data punch was designed to reduce key punching and proofing labor and to eliminate transcription errors. It can be used wherever source data must be gathered at locations other than the data processing site. Typical in-plant uses are: Stock requisitioning, physical inventory, tool control, machine production recording, order invoicing routines. The machine records data in standard punch card code directly on a tabulating card at the point of origin. Cards prepared by the unit can be fed directly into any data processing system without transcription or additional preparatory steps. Con-



the Modern Way

TO CUT OFF AND FORM TUBING AND BAR STOCK *IN A SINGLE OPERATION*

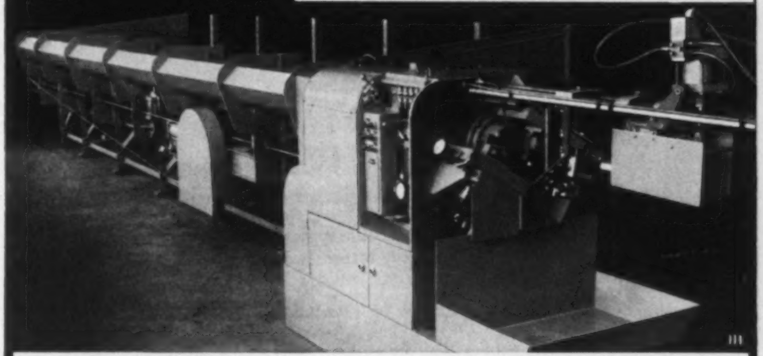
Here is a combination that feeds tubing and bar stock — automatically — to a fast, automatic cutting-off machine. Best of all, the pieces being cut off can be formed, grooved, flanged or chamfered at the same time.

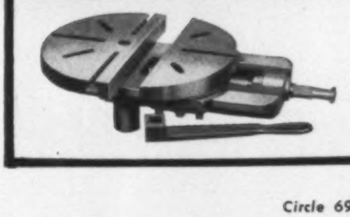
There are models that handle tubing, pipe and bar stock from ⅛″ diameter up to solid bar stock of 3″ OD and tubing up to 8″ OD.

Why not investigate?

WRITE FOR CATALOG

MODERN MACHINE TOOL CO.
2005 Losey St. • Jackson, Michigan





FREE TRIAL OFFER. Safe, positive, fast set-ups. The Modern Safety Drill Table handles odd, irregular shapes without V-blocks, clamps or parallels. Ideal for maintenance work. Guaranteed to save its cost in labor alone every 6 months. Sizes from 8″ to 27½″ dia. Try it at our expense. No obligation.

Circle 696 on Page 19

new! LOW COST, VERSATILE

VAC-U-LIFTER

multi handler

Easy, QUICK one-man operation eliminates slings, chains or ropes! Can be fitted to the job, large or small, with powerful instantaneous grip . . . *lifts up to 2,000 lbs.*

Meets the approved safety requirements and features the exclusive QUICK CONNECT AUTO-LOK COUPLING.

ONLY

$695.00

COMPLETE WITH PAD

Auto-Lok Coupling permits the speedy attachment of:

1. Various sizes and shapes of oval and round vacuum pads
2. Beams in variable lengths with adjustable pads
3. The special self-contained 90° Powered Turnover Unit for those difficult inspection jobs and turning operations.

VAC-U-LIFT CO.
Salem Illinois

FREE TRIAL

We are so sure you will be completely satisfied that the VAC-U-LIFTER will save you time and costs with your handling problems that we offer it to you on a 30-DAY FREE TRIAL basis in your plant!

If not completely satisfied, you may return the unit and we *will even pay the freight!*

MAIL COUPON TODAY! - VAC-U-LIFT CO., Salem, Illinois

☐ Mail more information

☐ Have Representative call

Name.................................

Company.................................

Address.................................

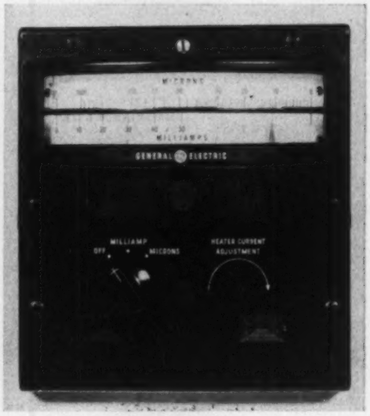
City.................................State.................

VL-262

Circle 697 on Page 19

ventional 80 or 51 column cards or multiple part card sets may be used. The machine can also serve as an auxiliary in keypunch departments for adding information to previously punched cards and for entering special codes or instructions in recreating data from damaged cards. **Addressograph - Multigraph Corp.,** 1200 Babbitt Rd., Cleveland 17, Ohio.

Circle 442 on Page 19



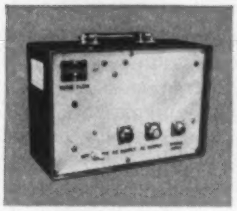
Indicator Controller

Thermocouple vacuum-gage indicator-controller is especially adaptable to close-tolerance control systems. It is intended for a wide range of vacuum system applications including electronic tube evacuation, metalizing, distillation, and heat treating. Instrument can initiate control on either increases or decreases in pressure. Control point is adjustable over entire calibration range. Feature of the system is that it offers excellent indication and control tolerances around the setpoint. Instrument is connected to vacuum systems by a six-foot cable and $1/8$-inch diameter standard pipe thread gage tube. Latter can also be attached using a standard O-ring seal. **General Electric Co.,** Schenectady 5, N. Y.

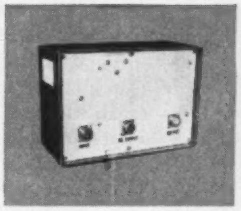
Circle 443 on Page 19

Motor Starters

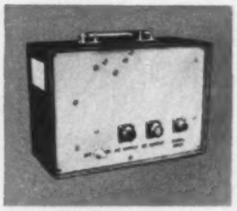
Line of across-the-line motor starters is offered in seven starter sizes—Size 00 through Size 5—with maximum ratings from $1\frac{1}{2}$ hp, 220 v; 2 hp, 440-550 v up through 100 hp, 200 v; 200 hp, 440-550 v. Start-



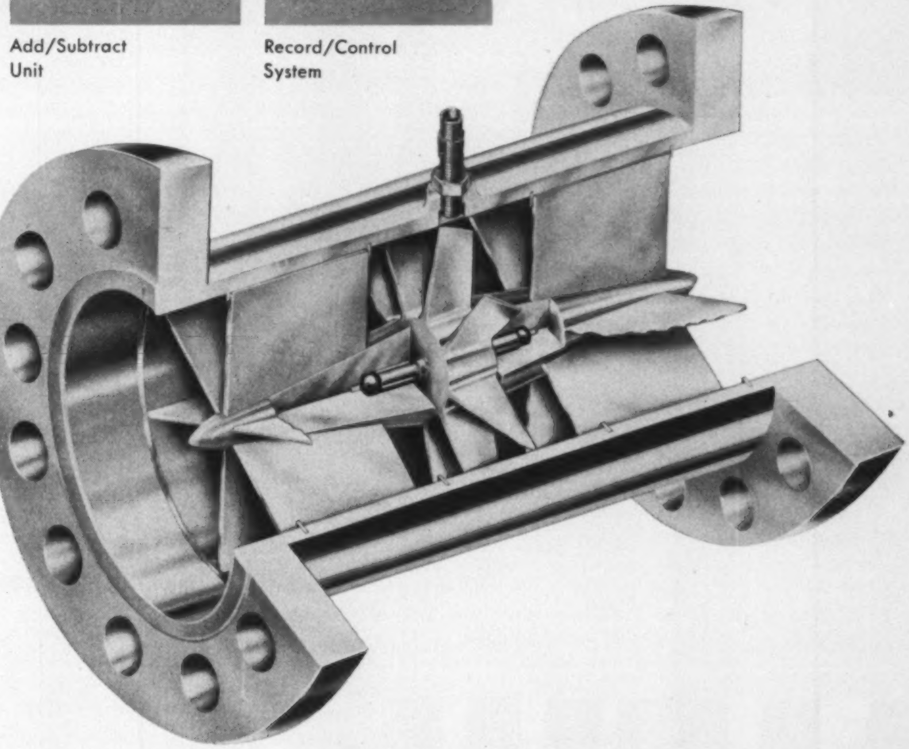
Totalizer/
Transmitter



Add/Subtract
Unit



Record/Control
System



CORROSIVE AND ABRASIVE FLUID FLOW ACCURATELY CONTROLLED

...even with reversals in flow direction

The Halliburton Turbine Flow Meter is a rugged, in-line instrument designed to electronically measure the flow of corrosive and abrasive fluids. It is designed for minimum maintenance and *no lubrication*. Companion readout equipment available for the Flow Meter includes:

ADD/SUBTRACT UNIT which utilizes the Flow Meter's unique ability to accurately measure fluid flow in either direction. This unit transforms flow data transmitted from the Flow Meter into a constant inventory reading of *any* storage system while it is being filled or drawn upon.

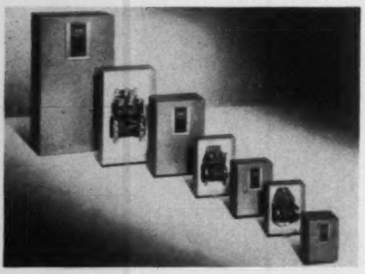
The new Halliburton Flow Meter Brochure tells the full story of these two new instruments plus the Flow Analyzer, Rate Meter, Totalizer/Transmitter, Batch Indicator, and Record/Control System. Write for a copy today to...

SPECIAL PRODUCTS DIVISION

New ideas...
reliable products...
seasoned experience...

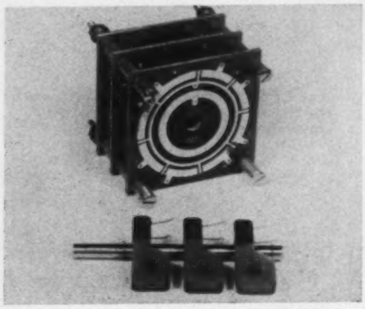
Halliburton
COMPANY . DUNCAN, OKLAHOMA

Circle 698 on Page 19



ers feature greater reliability, increased mechanical life, and smaller size, as well as double break contacts of an improved, cadmium oxide silver that resists welding. Totally enclosed arc chambers confine the arc, limit ionization and the resulting heat, and greatly increase current interrupting capacity. The starters incorporate a high-efficiency magnet. This magnet has the advantage of two working pole faces and features a permanent air gap. Solder pot overload relays utilized by the starters are both trip-free and tamperproof. Automatic reset bimetallic overload relays can be supplied in place of solder-pot relays. Range of Nema type enclosures are styled to satisfy all operating conditions. **Allen-Bradley Co.,** 136 W. Greenfield Ave., Milwaukee 4, Wis.

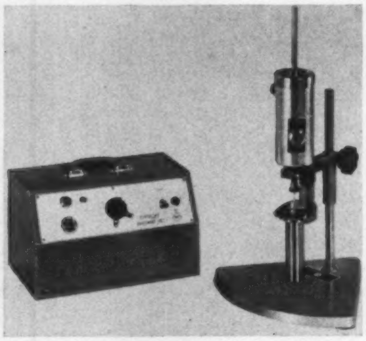
Circle 444 on Page 19



Commutating Switches

Line of commutating, programming, and sampling switches are customarily motor driven at speeds up to 3600 rpm but can also be coupled to stepping motors, timing motors, or manual drives. They are applicable to telemetry, data handling, pulse generation, and programming systems. Rhodium plated contact surfaces are bonded to dielectrics such as glass epoxy, paper epoxy, or synthetic mica. Packaging ranges from sealed subminiature modules for airborne and missile applications to rack mounting for ground support and industrial use. Any number of circuits, poles, and contacts can be packaged as a single, integral unit. **Rotary Devices Corp.,** 40 Jay St., Englewood, N. J.

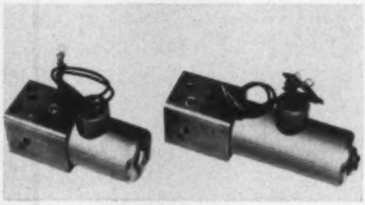
Circle 445 on Page 19



Viscometer

Viscometer for laboratory and in-line process use is capable of 15 readings that can be used to produce very accurate rheograms and automatically control manufacturing processes, when flow characteristics are a function of product quality. The Epprecht viscometer speed varies from 5.6 to 352 rpm with shear rates from 1 to 2000 seconds and shearing force from 2 to 200,000 dynes per square cm. Device measures viscosity of liquids, pastes and many plastic materials in the range from 0.2 to 10,000,000 cps. **J. W. Fecker, Div., American Optical Co.,** 6592 Hamilton Ave., Pittsburgh 6, Pa.

Circle 446 on Page 19



Directional Valves

Line of miniature directional valves has been developed for use in oil hydraulic systems. The

LOW COST AIR VIBRATORY FEEDERS

- simple design
- trouble-free operation

Navco's new line of air vibratory feeders feature a patented simple design. Low in original cost, they use Navco's one-piece air vibrators . . . cut maintenance costs up to 80%. Vibrators can have tapped ports for exhausting directly to remote areas in food or phamaceutical plants. Wide range of flow rates can be obtained by varying the air pressure range from 20 to 70 p.s.i. Solenoid valves can be used for completely automatic control.

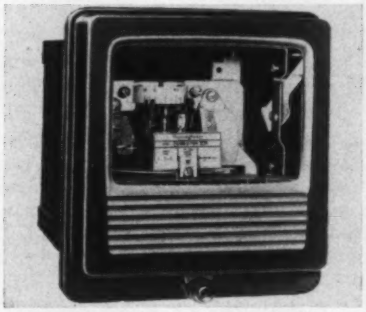
FOR NAVCO FEEDER CATALOG WRITE DEPT. A-6

NAVCO® NATIONAL AIR VIBRATOR CO.
435 Literary Road • Cleveland 13, Ohio

Circle 699 on Page 19

valves are designed for use in small volume systems typically used for jig positioning and clamping, hydraulic gear shifting and clutching on machine tools, and venting on hydraulic system relief valves. They are suitable for operation to 1000 psi and have a maximum capacity of 2 gpm. Simple, long life ac and dc solenoids, with low current consumption, are available in all standard voltages. These gasket-mounted valves, designated DIL, are offered as 4-way valves in both single and double solenoid models. They are available with a variety of spool types to suit operating requirements. **Vickers Inc., Div., Sperry Rand Corp.,** Detroit 32, Mich.

Circle 447 on Page 19



Current-Sensing Relay

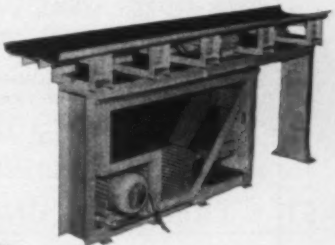
Relay (Type COD) with independently adjustable high and low-current stationary contacts for switching and control operations is available with either a tapped or a nontapped electromagnet. The tapped relay is supplied in the following ranges: 0.5 to 2.5, 2 to 6, and 4 to 12 amperes ac. The scale on this relay is marked in per cent of tap value with a range of 80 to 110 per cent. The nontapped unit is available with a range of either 0.5 to 2.0 or 1.5 to 6 amperes ac. The scale on the nontapped relay is marked directly in amperes. The minimum setting between the high and low-current contacts of the relay is 3 per cent of tap-value current for the relay with taps, and 0.1 ampere ac for the relay without taps. At tap-value current, when using the minimum tap setting, the burden of the tapped relay is 2.38 va. The nontapped unit has a burden of 0.48 va at the minimum current setting, and 7.6 va at the

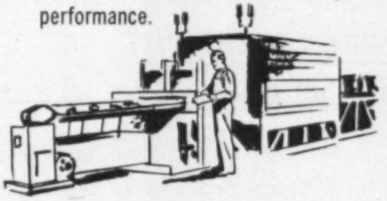
WHIZZING LUGGAGE ALONG AT 300 FEET PER MINUTE . . . OR INCHING FORGINGS FORWARD AT 300 FEET PER HOUR . . .

Unique traveling diverter delivers luggage to claiming counter at the end of the incoming conveyer lines at United Air Lines' bright new terminal at New York's Idlewild International Airport.

IT'S ALL IN A DAY'S WORK FOR MATHEWS ENGINEERS

Whether it's a high-speed belt conveyer system smoothly handling the luggage of modern air travelers, or a **LIVE-FLO** oscillating conveyer upon which small parts are quietly but surely creeping along, you can be sure that it's **Mathews engineered** to deliver outstanding performance.





A new concept in oscillating conveyers—LIVE-FLO—is without equal where slow speed and complete control are important

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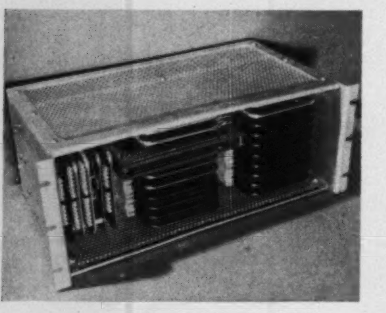
PACIFIC COAST DIV. . . . MATHEWS CONVEYER COMPANY WEST COAST, SAN CARLOS, CALIFORNIA
CANADIAN DIVISION . MATHEWS CONVEYER COMPANY, LTD., PORT HOPE, ONTARIO.

MCC MATHEWS
Over Fifty Years of Leadership in Mechanized Handling

Circle 700 on Page 19

maximum setting. **Westinghouse Electric Corp.**, P. O. Box 2099, Pittsburgh 30, Pa.

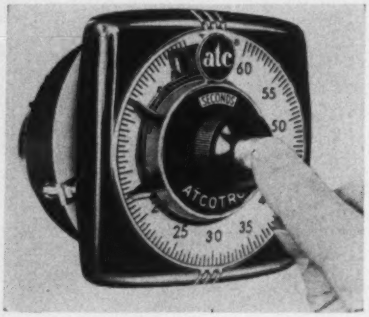
Circle 448 on Page 19



Instruction Memory

High-speed magnetic core instruction memory in several standard sizes operates at one megacycle, with an access time of 0.4 microsecond, using nondestructive readout BIAX memory elements. Applications include high-speed general purpose computers, ground check-out equipment, nuclear reactor start-up, process control computers, and any system where prestored programs or data are needed. Two standard sizes are presently available, 128 words and 512 words, with 24 bits per word. Other sizes up to 1024 words and 36 bits per word can be built. Power consumption of this device is only 50 w for a 512 word memory. Operation at ambient temperatures from 0 to 50 C is offered. **Aeronutronic Div., Ford Motor Co.**, Ford Rd., Newport Beach, Calif.

Circle 449 on Page 19



Pushbutton Timer

Device provides automatic shut-off and reset. It is available for either ac or dc operation. Model 309 Atcotrol timer is available in 16 standard dial ranges from 6 seconds to 60 hours. It can also be provided for special ranges and voltages. Possible applications include equipment such as lapping machines, mixers, coffee making machines, ovens, and insulation testing machines. Features of this pushbutton timer are 0.0025 repeat accuracy; a metal-to-neoprene impingement clutch; and one S.P.D.T. snap-action load contact in series with the motor, plus option of additional S.P.D.T. snap-action independent load contact. **Automatic Timing & Controls Inc.**, King of Prussia, Pa.

Circle 450 on Page 19

Self-Balancing Indicators

Units provide accurate, automatic, rapid indication of a wide variety of industrial processes. They can be used with hundreds of sensing elements connected through any type of multipoint switch or connector panel. Indicating controllers also provide two (off-on) or

PIONEER in WINDERS, etc., for over 40 YEARS!!

(thousands of applications)

GLOBE Armature Equipment . . .
processes all types of armatures!!!
"FAS-WOUND" or Anchored Loops.

PERFORMS SUCH OPERATIONS AS:

- INSULATE THE SLOTS
- INSTALL COMMUTATOR
- WIND THE ARMATURE
- CONNECT THE COMMUTATOR
- HOT-STAKE CONNECTIONS
- WEDGE THE SLOTS

ARMATURE INSULATING MACHINE

Individual Machines with Automatic Cycles,
or, Grouped into a Full Automation System.

FAST * PRECISE * UNIFORM OUTPUT

ALSO . . . winders of all types . . . for all duties

ARMATURE WINDING MACHINE

- **Single, or Multiple Spindle . . .**
- **Bench, Pedestal, or Bed Types...**
- **Automatic, Semi-, or Manual . . .**
- **Six Basic Sizes—Full Range . . .**
- **Turrets and Automations . . . .**

TURRET TYPE WINDER

TRANSFORMER WINDER

Let US help YOU . . . on Armatures, Stators & Coils

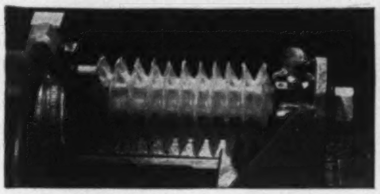
The GLOBE TOOL and ENGINEERING Company

5078 KITRIDGE RD. DAYTON 24, OHIO

Circle 704 on Page 19

HIGH-FLEX DUST BOOT

electronically sealed plastic film



Inexpensive dust boot (bellows) seals hermetically against abrasive chips, or dust, or against corrosive liquids; high flexibility often permits installing on existing air or hydraulic cylinders without increasing space requirements. Any length desired can be furnished, with price directly proportional to number of convolutions.

Also used to protect traverse screws and ball slides. When transparent plastic is used, any oil leakage is trapped and revealed. Boot is recommended for —30° to 210° F and is available with no tooling charge in a wide range of standard sizes from 1" to 13" OD. Delivery is 1 to 3 weeks. Also made in custom sizes, colors and shapes — in quantities from 1 to 1000. **Write or call for engineering data and detailed recommendations** (no salesman will come). —**Gagne Associates, Inc., 50 Wall St., Binghamton, N.Y., phone RA 3-7519.**

Circle 701 on Page 19

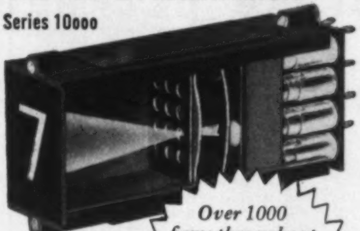
ALL DIGITS CAN BE READ FROM ANY ANGLE

IN-LINE DIGITAL READOUT

featuring

ONE-PLANE PRESENTATION

Series 10ooo



Over 1000 firms throughout the world in just a few years prove unprecedented acceptance of IEE digital readouts.

PRICE COMPLETE

$18.00

QUANTITY PRICES ON REQUEST

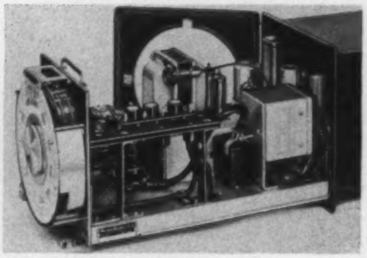
Binary-To-Decimal Decoders Available.

WRITE TODAY FOR COMPLETE SPECIFICATIONS

Representatives in principal cities

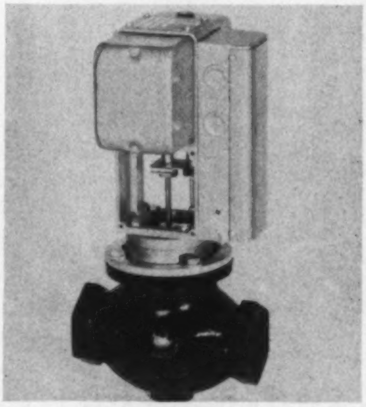
INDUSTRIAL ELECTRONIC ENGINEERS, INC.
5528 Vineland Avenue
North Hollywood, California

Circle 702 on Page 19



three-position control of processes. Only 56 square inches of panel space is required for either of these instruments. The instruments are built with bridge or potentiometer circuits. More than 50 range scales and calibrations are available for use with all standard sensing elements. Instrument accuracy is 0.25 per cent of full scale; sensitivity is 0.125 per cent, uneffected by normal variations in line voltage, amplifier tubes, or component parts. **Thermo Electric Co. Inc.,** Saddle Brook, N. J.

Circle 451 on Page 19



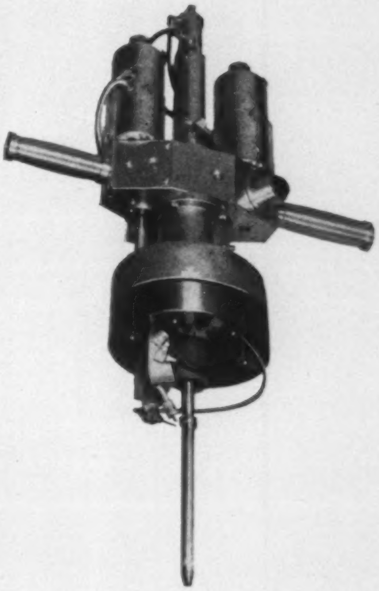
Proportioning Gas Valve

Globe type proportioning gas valve with electrohydraulic actuator combines high-low-off fuel control with fully proportioned control between high position and low position. Designated H-119, this valve is designed for use with such equipment as packaged boilers, furnaces, and heaters. It is available for line sizes up to four inches and for all gaseous fuels at pressures up to 15 psi, according to size. Its control circuit is a standard 135 ohm potentiometric proportioning type for operation on 24 volts ac. **Industrial Controls Div., General Controls Co.,** 801 Allen Ave., Glendale 1, Calif.

Circle 452 on Page 19

AMECO

PORTABLE TUBE WELDING GUN with rod additive



This unit is used to weld tubes into tube sheets where additional weld metal is required. For ferrous and certain non-ferrous applications.

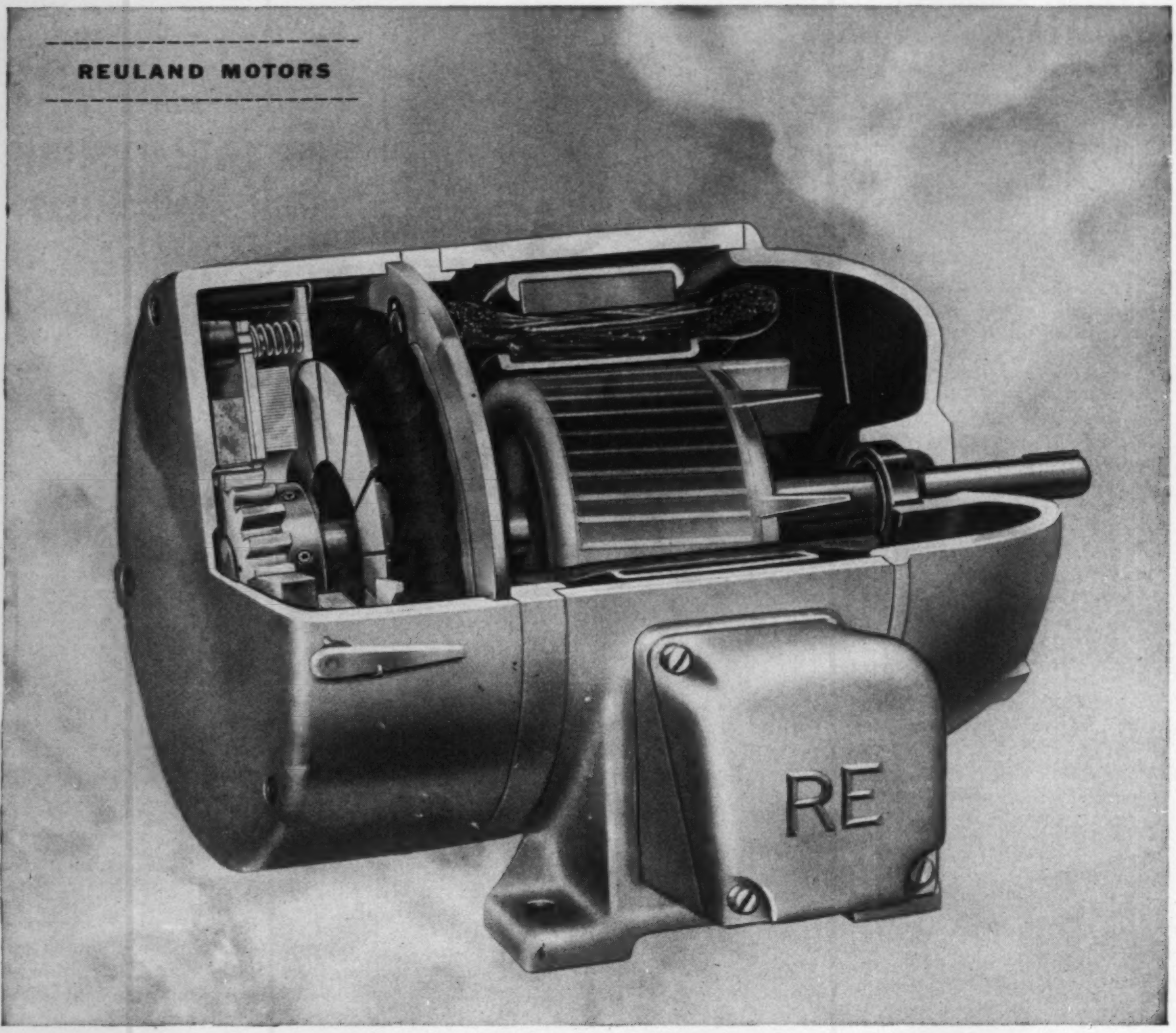
- Handles from 5/8" to 1¼" dia. tubes.
- Uses standard 1# wire spools (not shown).
- Fingertip adjustment of speed for both the tungsten and wire travel.
- Automatic cycling with wire retract.
- Can be used in both horizontal and vertical position.

FOR COMPLETE DETAILS, WRITE OR CALL:

AMECO

AUTOMATION MACHINES & EQUIPMENT CO., INC.
3130 W. Mill Rd.
Milwaukee 9, Wisconsin
FLagstone 2-7250

Circle 703 on Page 19



Reuland motor-and-magnetic-brake package

...complete from one dependable source!

Reuland manufactures its own magnetic brakes, as well as electric motors, and offers the most versatile selection of tailored-to-your-equipment *brakemotor* packages available anywhere. Reuland's many hundreds of combinations of H.P., speed, special drive motors and brake sizes, provide an almost unlimited coverage of O.E.M. and user requirements!

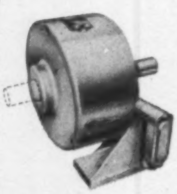
So, whatever your *brakemotor* needs may be, standard or special, let Reuland supply the complete answer in one, compact, smartly-designed power package. One source of supply for brake and motor saves time for your Engineering and Purchasing Departments... one nameplate establishes dependable, nationwide service responsibility!

Refer to Sweet's 1961 Product Design, Section 7a/RE

MODERN POWER FOR MODERN-DAY PRODUCTS

... all in lightweight, cool-running aluminum frames!

REULAND MOTORS



BRAKES AVAILABLE IN ALL 3 MOUNTINGS... FULFILLS J.I.C. SPECIFICATIONS!

1. Direct endbell type for mounting over motor's shaft.
2. Foot mounted, for mounting over existing shaft.
3. Foot mounted—complete with own bearings and shaft.

- Automatic Lining Wear Adjustment
- Manual Release—Automatic Reset
- Mount in any position
- No Levers or Linkage
- One-Piece Housing
- One-Half Conventional Length
- Wide Range of Ratings

Our new 8-page catalog, No. GS8-30-0, will come in handy. Sent complete with prices and engineering drawings on request.

REULAND ELECTRIC COMPANY
WESTERN DIVISION: *Alhambra, Calif.*
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Distributors in all principal cities

AUTOMATION

catalogs and literature

Latest automation information. For copies use card on page 19.

Nuclear Gages

Ohmart Corp., 2236 Bogen St., Cincinnati 22, Ohio—6 page pamphlet—Bulletin 105-C presents details regarding basic systems employing nuclear gages for controlling specific gravity or density and liquid or interface levels. Fundamental ideas of using gamma radiation are described as well as components required for a complete system. Schematic diagrams suggest installations and photographs show equipment. Methods of zero suppression, use of associated instruments, temperature regulation, safety, calibration, and maintenance are detailed. Various users and uses are indicated.

Circle 453 on Page 19

Exploded View Illustrations

Mischka Co. Inc., 1511 Brookpark Rd., Cleveland 9, Ohio—28 page catalog—Booklet describes this company's work in the preparation of exploded view illustrations. Details are provided on the way these illustrations are prepared, and some of the uses to which they are put. Examples of typical exploded view art work are given.

Circle 454 on Page 19

Finishing Equipment

R. C. Mahon Co., P. O. Box 4666, Detroit 34, Mich.—12 page booklet—Catalog A-661 describes a wide range of metal finishing and processing equipment. Covered are: Metal cleaning and surface preparation units. pickling or rustproofing; spray, dip, and flow coating equipment; drying, baking, and processing ovens; complete finishing systems; special processing equipment; control components; and dust and fume control equipment. Photographs illustrate the various units.

Circle 455 on Page 19

Trolley Conveyors

Link-Belt Co., Dept. PR, Prudential Plaza, Chicago 1, Ill.—60 page handbook—What a trolley conveyor can do to reduce manufacturing and handling costs and how to select the right trolley conveyor for any requirement are the two main topics of Handbook 2730. Examples of installations from small, relatively simple jobs up to complex systems found in some plants are shown, with photographs and layout drawings. Details are also provided on Trukveyors and power-and-free conveyors which combine powered trolley conveyors and unpowered, monorail-type free conveyors to route, store, and circulate.

Circle 456 on Page 19

Solenoid Valves

Automatic Controls Div., Hays Manufacturing Co., 801 W. 12th St., Erie, Pa.—two 8-page bulletins—Folders contain data regarding a line of Electroflo solenoid valves designed to provide dependable service even under critical and difficult operating conditions. Folder 2110-6 covers the small size models of these valves and Folder 2111-7 the larger ones. Various applications and models are illustrated.

Circle 457 on Page 19

Data Processing Equipment

Friden Inc., San Leandro, Calif.—12 page booklet—Brochure contains data regarding a line of tape-talk machines for integrated data processing. Machines covered include such devices as Flexowriters, Justowriters, Computypers, Teledata, Selectadata, and auxiliary tape punches and readers. Several different types of machines are illustrated.

Circle 458 on Page 19

Jig Borers

Fosdick Machine Tool Co., Cincinnati 23, Ohio—22 page booklet—Bulletin 560 describes two jig borers, designated Models 44 and 54. These machines can be equipped with tape control in three axes, giving them full numerical depth control as well as positioning control. Units combine versatility, speed, and extreme accuracy.

Circle 459 on Page 19

Thread Rolling Machine

Landis Machine Co., Waynesboro, Pa.—20 page booklet—Booklet LHY-10 describes various thread rolling applications which can be performed on a Lanhyrol thread rolling machine. Photographs illustrate the various applications. Booklet gives detailed machine specifications.

Circle 460 on Page 19

Weight Sensing Systems

Exact Weight Scale Co., Dept. "P", 920 W. Fifth Ave., Columbus 15, Ohio—8 page bulletin—Reference Manual, Form 3513, is designed as an idea stimulator to show how the principle of weight sensing, or measurement of force, can be utilized to perform a wide variety of production and quality control functions. Diagrams show representative applications of this line of automatic weight sensing systems. Each system is custom engineered to fit a specific application.

Circle 461 on Page 19

Adapter Fittings

Parker Fittings & Hose Div., Parker-Hannifin Corp., 17325 Euclid Ave., Cleveland 12, Ohio—16 page booklet—Catalog 4360 on pipe thread and straight thread adapters for tubing system connections has been revised and expanded to include straight thread adapters with new metal sealing rings. Specification charts, line drawings, and photographs of the various units are provided.

Circle 462 on Page 19

Electrical Components

Universal Relay Corp., 42 White St., New York 13, N. Y.—20 page booklet—Catalog covers a line of electrical components including relays, switches, rotary solenoids, rotary steppers, timing devices, transformers, rectifiers, etc. Specifications as well as illustrations of the various items are provided.

Circle 463 on Page 19

Magnetic Disc Brakes

Stearns Electric Corp., 120 N. Broadway, Milwaukee 2, Wis.—8 page bulletin—Bulletin 605 gives information on a line of magnetic disc brakes. Line includes H-40 Series with torque ranges of 1 lb-ft and 3 lb-ft for mounting on NEMA 40 frame motors; the HTC-50 Series from 1½ to 15 lb-ft for mounting on motor frames 55C, 66C, 182 and 184; the HT-70 Series from 10 lb-ft to 105 lb-ft for adaptation to 213C, 215C, 254UC, 256UC, 284UC, 286UC motor frames; the H-80-7 Series for special adaptation to older frame motors; the new 42,000 series with torque ranges from 125 lb-ft to 575 lb-ft for NEMA frames 324U through 405U. Brakes for Class I, Group D, Class II, Groups E, F, and G Underwriters' listed, indicating various brakes for both motor and floor mounting.

Circle 464 on Page 19

Metals Handbook

American Society for Metals, Metals Park, Novelty, Ohio—32 page handbook— Illustrated brochure describes the contents of the Metals Handbook, 8th Edition, Vol. 1, "Properties and Selection of Metals." The brochure includes actual examples from each of the handbook's major sections, with information on how the book was compiled by 1335 metalworking experts in association with 83 author committees representing major areas of industry.

Circle 465 on Page 19

Motion Detector

*Gaylord Controls, Div., Gaylord Products Inc., 1918 Prairie Ave., Chicago 16, Ill.—4 page pamphlet—*Bulletin describes a micro motion detector capable of sensing extremely slow speeds or lack of motion; also direction or reversal of motion. Motion may be either rotary or linear; if the latter type, some simple drive such as a wheel would be employed to convert to rotary motion. Life of the unit is well over 200,000 cycles. Temperature operating range is −40 to +240 F. Diagram illustrates construction features of the unit.

Circle 466 on Page 19

Duplex Grinder

*Bryant Chucking Grinder Co., Springfield, Vt.—4 page pamphlet—*Specifications and details on a double-end internal grinder are provided in this bulletin. The machine was specifically designed for grinding both a straight and a tapered bore at a single chucking. Included in the brochure are detailed descriptions of machine movements, a schematic, close-up of tooling area, and complete operating specifications.

Circle 467 on Page 19

Magnetic Starters

*Furnas Electric Co., 1128 McKee St., Batavia, Ill.—4 page pamphlet—*Brochure 14-B2 describes a line of magnetic starters featuring unitized construction with all components front-removable. These starters are available in sizes 2 and 2½. Thermal overload relays have trip indicator, are nonadjustable and tamper proof. Third overload can be either factory or field mounted. Dual voltage 110/220 or 220/440 dual cycle 50-60 coils are standard. Up to three auxiliary interlocks may be added to each unit for additional control circuits.

Circle 468 on Page 19

Panel Instruments

*Electronic Sales Div., DeJur-Amsco Corp., 45-01 Northern Blvd., Long Island City 1, N. Y.—12 page catalog—*Catalog P1 covers line of electrical indicating panel instruments. Detailed specifications, outline drawings, and general information covering a wide range of miniature and full size units from ½-inch diameter to 4½ inch are included.

Circle 469 on Page 19

Tape Preparation Equipment

*McDonnell Aircraft, Box 516, St. Louis 66, Mo.—2 page pamphlet—*Bulletin contains data describing a machine, designated TAPE, that automatically programs punched tape for a variety of automatic checkout and machine control requirements. The device's logic circuitry electronically analyzes word-group and numerical keyboard commands and converts them to complete coded programs. Punching mechanisms instantly deliver the finished tape. Machine performs such operations as editing, verifying, duplicating, and correcting of existing tapes.

Circle 470 on Page 19

Synchronous Generators

*Electric Machinery Mfg. Co., 800 Central Ave., Minneapolis 13, Minn.—2 page pamphlet—*Publication 2100-PRD-254 describes a line of synchronous, ac generators rated 187 kva and larger. The machines are nonpackaged, and feature dripproof construction, direct connected exciter, through-greased bearing, roomy terminal boxes, and end-to-end ventilation. The units are designed for low stator core loss and are available in all standard voltages, 60 or 50 cycles, single or 3 phase. Single or 2 bearing construction is optional.

Circle 471 on Page 19

Manipulator-Vehicle Systems

*General Mills, Nuclear Equipment Dept., 419 N. 5th St., Minneapolis 1, Minn.—20 page booklet—*Manipulator-equipped vehicle systems for remote handling operations are outlined in Bulletin 6-B130. Both manned and unmanned systems and suggested applications are discussed. Typical vehicle systems are proposed for use in situations involving explosive, radioactive, toxic, or otherwise hostile environments.

Circle 472 on Page 19

Industrial Transformers

*Chicago Standard Transformer Corp., 3501 W. Addision St., Chicago 18, Ill.—32 page catalog—*Catalog CS-101 lists approximately 900 stock transformers for industrial applications. These transformers range from units for high reliability military applications to low cost commercial transformers. Detailed dimensional information as well as complete electrical specifications are given for all units.

Circle 473 on Page 19

Vacuum Ion Pumps

*Consolidated Vacuum Corp., 1775 Mt. Read Blvd., Rochester 3, N. Y.—8 page bulletin—*Bulletin 6-2 covers a line of vacuum ion pumps that use no fluid, need no baffles, and have no outlets. Specifications for several models are given. Schematic diagrams illustrate construction details of the various pumps.

Circle 474 on Page 19

Servo System Analyzers

*Servo Corp. of America, 111 N. South Rd., Hicksville, L. I., N. Y.—2 page pamphlet—*Six ways to simplify control design are shown in Bulletin NB-660. Bulletin illustrates various Servoscope(R) analyzer models used for fast problem solving in servo system design, debugging, production, teaching, and testing. Included is a section on a new Servoflight(R) autopilot analyzer. Also described is a method of servo system synthesis and analysis called Servolab(TM). Infrared radiation detection is covered. Bulletin illustrates Servotherm(R) infrared radiation pyrometers and thermistor bolometers, together with basic Servofrax(R) arsenic trisulphide glass lenses and other components for use in infrared devices.

Circle 475 on Page 19

Set Point Controller

*West Instrument Corp., 4363 W. Montrose Ave., Chicago 41, Ill.—4 page pamphlet—*Data are contained in Bulletin JY on a digital set point controller that generates a current to initiate control actions when the voltage from a transducer (such as a thermocouple) differs from a set point voltage selected on a dial. A chart indicates specifications for various models. Dimensional and circuit diagrams, as well as a photograph of the controller, are provided.

Circle 476 on Page 19

Welding Machinery

Acro Welder Mfg. Co., 1719 W. St. Paul Ave., Milwaukee 3, Wis. 16 page booklet— Bulletin 261 illustrates 68 special welding units with brief captions where necessary to describe the specific functions of the units. Models are departmentalized under Acromatic special resistance welders, Acro-Arc special arc welders, Acro standard resistance press welders, Arco-Magnetic magnetic force welders, and Acro standard resistance welders.

Circle 477 on Page 19

Photoelectric Controls

Electronics Div., Cramer Controls Corp., Centerbrook, Conn.—80 page handbook— Handbook details how Infrabeam photoelectric controls solved 40 typical operational problems in materials handling, equipment and personnel protection, production, and automatic control. Modulated infrared radiation enables this device to operate by reflected or interrupted beam over an extremely long range, even under high general light conditions.

Circle 478 on Page 19

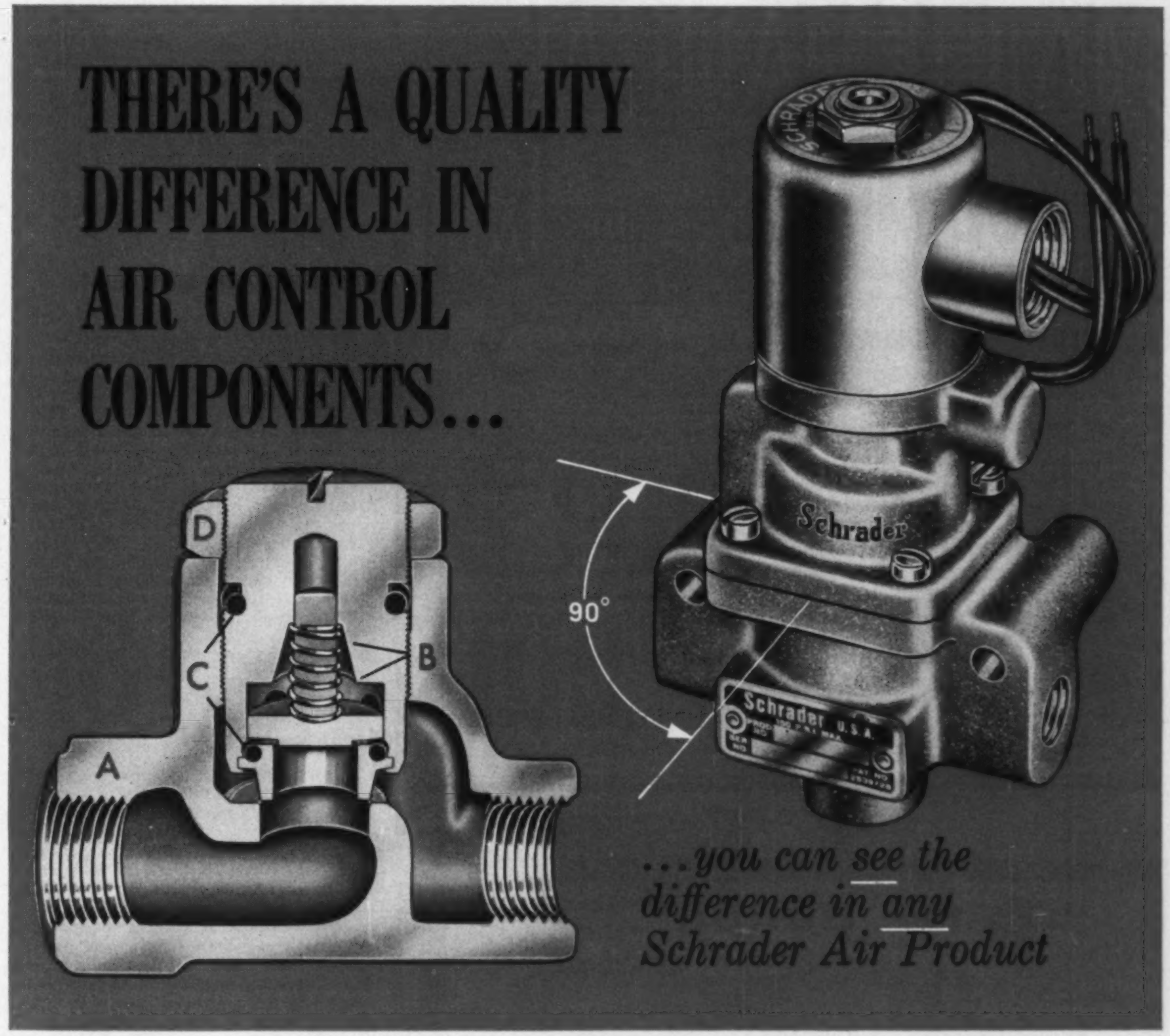
Blanking Press

Hydro-Cam Engineering Co., 1900 E. Maple Rd., Troy, Mich.—6 page pamphlet —Catalog HIP-26 describes and illustrates a 120-stroke per minute, triple-action hydraulic press used to produce high quality parts in conjunction with Smooth-Edge blanking dies. Precision stamped low carbon steel, stainless steel, aluminum, brass, and copper blanks are produced in a single operation from coil or strip stock. Catalog also covers tungsten carbide and tool steel dies for producing electric motor rotors and stators, business machine components, gear racks, transformers, E & I laminations, solenoid laminations, and shims.

Circle 479 on Page 19

Motor Drives

*Reliance Electric & Engineering Co., 24701 Euclid Ave., Cleveland 17, Ohio—88 page catalog—*Catalog G-100 covers a line of Reeves Vari-Speed Motodrives, ¼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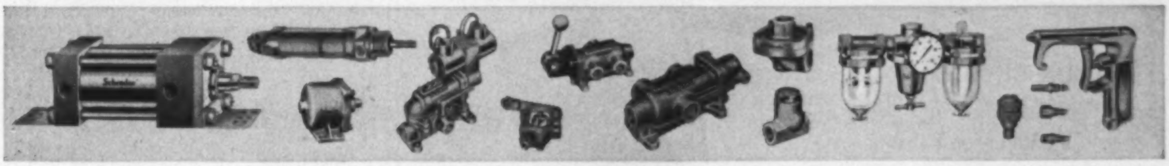

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Circle 480 on Page 19

Magnetic Conveyor Controls

Electronic Controls Div., Flo-Tronics Inc., 712 W. Ontario Ave., Minneapolis 3, Minn.—6 page pamphlet—Bulletin MP50-6011 covers a line of fully automatic control systems for package, part, unit, or container conveyor lines. These Mag-Pac control systems are designed to open the way to full-scale conveyor line automation for small and medium size manufacturing, warehousing, and distributing firms as well as highly complex conveying systems requiring hundreds of command or control operations. Specific conveyor system applications include order filling, product sorting, selecting from live storage, conveyor loading and unloading, transferring and diverting. Control units are available either as standard or custom models to meet varying requirements.

Circle 481 on Page 19

Limit Switch

Micro Switch, Div., Minneapolis-Honeywell Regulator Co., Freeport, Ill.—2 page pamphlet—Data Sheet 183 contains data regarding a Model 1LS501 limit switch that combines features of compactness and sealed construction with a built-in indicating lamp that tells whether or not the circuit is being controlled. The switch is especially suitable for use in areas where more than one limit switch is employed, such as on a packaging line or machine tool. Characteristics: Operating force, 3 lb maximum; full overtravel force, 4 lb maximum; differential travel, 12 degrees maximum. Switch is rated at 10 amp 120 vac; ½ hp, 120 vac.

Circle 482 on Page 19

Electroplating Processes

Hanson-Van Winkle-Munning Co., Church St., Matawan, N. J.—24 page handbook—Bulletin EP-103 covers 19 plating and other metalfinishing processes and procedures. Solution preparation, types of deposits, operating conditions, equipment required, and applications are listed for each of the processes.

Circle 483 on Page 19

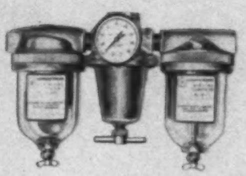
Circular Roller Chain

Acme Chain Corp., Holyoke, Mass.—4 page pamphlet—Bulletin No. 8 describes a circular roller chain designed especially to operate on curves. Its most common use is to act as a transfer medium from one straight line conveyor to another. When used for this purpose, it is usually made with standard pin extensions on every pitch. Design of the angular pin that enables the chain to function on a curve or circle is illustrated as well as typical arrangements of circular chain with tubing.

Circle 484 on Page 19

Circle 708 on Page 19

Air Motors—provide rotary or linear motion. Bulletin 70.



Filter-Regulator-Lubricator—for protection of air-powered equipment. Bulletin 65.

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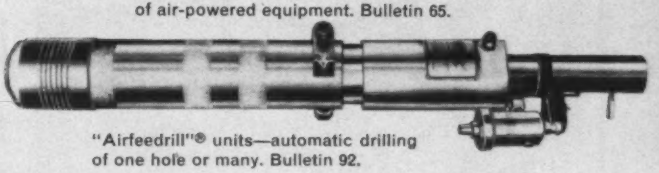
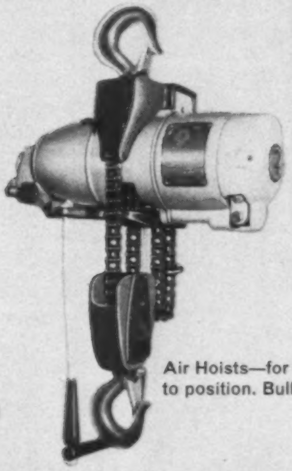
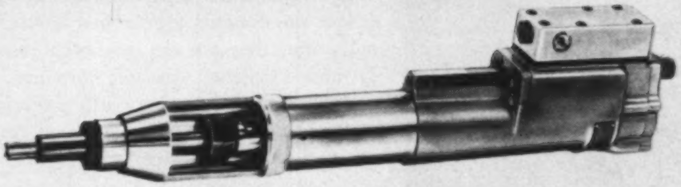


"Airfeedrill"® units—automatic drilling of one hole or many. Bulletin 92.



Air Hoists—for lifting to position. Bulletin 86.



"Tru-Thread"® tappers—for highest quality, precision-tapped holes. Bulletin 93.

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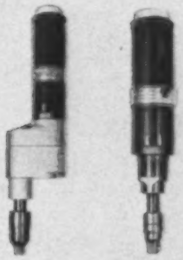

Center or offset spindles—for automatic screw driving or nut setting. Bulletin 16.

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Circle 709 on Page 19

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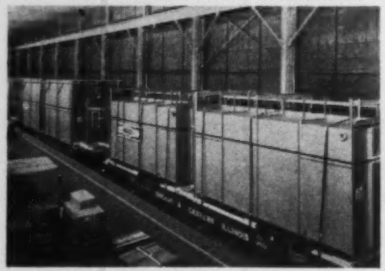

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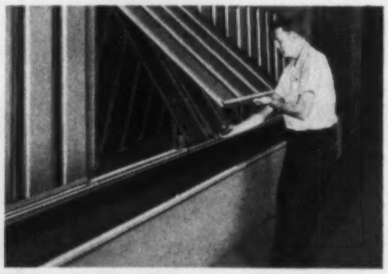

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Circle 710 on Page 19

AUTOMATION abstracts

AUTOMATIC DISASSEMBLY

By B. T. HENSGEN
Associate Director
Engineering Research Dept.
Swift & Co.
Chicago, Ill.

WHILE the packing industry has a traditional reputation for efficient scheduling of manual operations and has increased the mechanization of a good number of processes, it is only beginning to get into the field of automation.

To give you a concept of industry size, over 100 million head of livestock weighing over 38 billion pounds were processed in 2,800 census plants in 1958. The packing industry paid about $8 billion to the farmers and ranchers of America for this livestock and, in turn, produced approximately $11 billion worth of meat products.

The meat packers raw material is livestock which is produced in all parts of the country by thousands of farmers and ranchers. Meat animals are produced and offered for sale in every state of the Union. This wide availability and the comparative simplicity of the dressing and cutting operations leads to the existence of a great number of packing companies and several thousand small commercial slaughterers. The Crop Reporting Board, Agricultural Marketing Service, U. S. Dept. of Agriculture reports that there is a total of 3,144 slaughtering plants in the U. S. having an output of 300,000 lbs or more, live weight basis. In addition to these plants there are some 6,500 small plants slaughtering less than 300,000 lb live weight annually.

Now, let us consider the two principal sources of our meat supply—cattle and hogs. There are 11 breeds of cattle classified as beef and dual purpose animals, and 15 breeds of hogs which have breed association and registration records in the U. S. While the different breeds have distinct characteristics, there is a variation within the breeds which creates the very real problem of almost infinite variation in raw material characteristics.

Nor does the packer have control over the volume available to him at any one time. Livestock is sent to market every day, of course. But the variation in day to day receipts may be considerable in both amount and specie. A large number of hogs and very few cattle one day may be just reversed the next day—

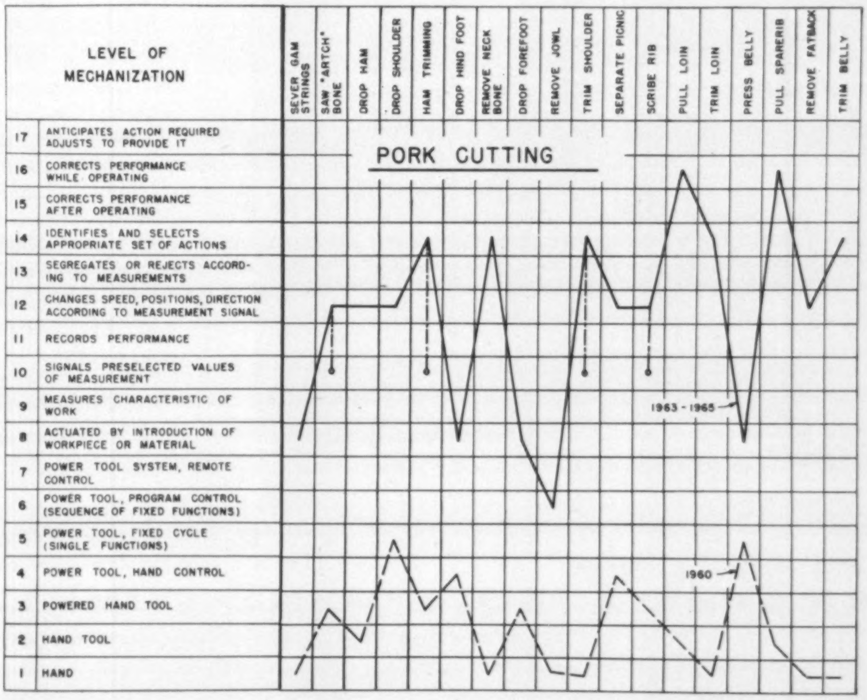

Fig. 1—Chart compares present extent of automation in pork cutting operations and what might be obtained in the future. Vertical axis is divided into 17 levels, increasing in sophistication with higher numbers. Horizontal axis shows separate steps in pork cutting operation

while at another time both may be either high or low.

The "automatic disassembly" problem, therefore, has these aspects: 1. Widely scattered production and processing. 2. Wide variation in raw material. 3. Considerable fluctuation in raw material supply.

Production in a meat plant begins on the dressing floors. The primary purpose of dressing livestock is to transform live animals into fresh meats. This involves the use of the most humane methods possible to dispatch the animal, the maintenance of high standards of technical sanitation, and a careful inspection by Department of Agriculture veterinarians to detect and remove diseased animals.

After dressing, the carcass is chilled by hanging in a cooler for a suitable period of time. Following the chilling operation the "side of beef" is then ready to enter marketing channels. This it may do in a number of ways: Whole side, fore-quarter, hind quarter, Primal cuts, or consumer style cuts. There are nine wholesale cuts and at least 37 distinct types of retail cuts.

Another major segment of meat processing is that devoted to production of pork. This begins with the hog dressing operation. As with beef, the pork carcass is chilled and then subdivided, or "disassembled," into the chops, cuts, and products normally required by the consumer.

While beef and pork meat items—fresh, cured and processed—comprise the major portion of the meat packers products, there also are the quite appreciable lamb and veal operations. The operations differ only in detail from beef and pork through the dressing, chilling and cutting operations.

Finally, there are the by-products of meat processing. By no means is this matter a minor one. From both the economic and volume standpoint, the by-products of meat processing are of vital importance. Among the better known by-products are: Fats and oils with their host of combinations, mixtures, etc., hides and skins, wool, tankage, animal feed ingredients, glands for pharmaceuticals, etc.

With this rather broad but brief look at the meat packing operation let us take a more detailed look at the problem of "disassembly" and its automation. *Fig.* 1 shows the relative mechanization levels of the pork cutting operation (the chart is after a device introduced by J. R. Bright in his book *Automation and Management*). The present profile (1960) shows a relatively low level of mechanization. Let us, therefore, consider some of the very important problems to be solved in the automating of this process.

Cutting, boning, and trimming operations demand a high degree of skill. Changing market conditions require corresponding changes in the kind of cuts to be made to get the maximum volume out of each animal. Accurate knife work is necessary in separating the cuts and trimming them. Otherwise appreciable loss in value can result. For example, a loss of $1 to $2 per animal can result from inaccurate or careless cutting and trimming.

This very fact offers a challenge to the automation expert. Human nature and ability being what they

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Circle 711 on Page 19

are, variations in performance are inevitable. If the miscut or overtrimming occurs at the expense of the more valuable cuts you lose value as stated above—if they occur in the other direction you detract from quality—even to the extent of causing a down grading of the more expensive cuts and again you lose money.

Therefore, the development of a reliably accurate automatic method has more than casual value in this area. However, it must be recognized that any mechanical method must be flexible in addition to being reliable. Some approaches to mechanized pork cutting equipment are under development. At the present time, however, there is no generally available equipment of any more than simple mechanization.

But now, let us take a forward look at this job of automating the disassembly process. In the past decade marvelous techniques have been developed and applied in many industries. The theoretical mathematicians have given us the basis for important advances in computer application, the physicists have contributed important discoveries in solid state circuitry, the electronic designers, the electrical and mechanical engineers all have assisted in adapting these basic concepts and discoveries into tools which are available to us today. With them we can attack the most complicated problems of movement, position, timing, gaging, control, etc. Therefore, I would like to dream a bit concerning my idea of the truly automatic "disassembly" line. The profile for my future process will look something like that shown as a solid line in *Fig.* 1. To show the degree of advancement the present profile is indicated by a dotted line. How will this come about?

Consider those operations at the 12th level. These are required to detect and determine information from a variable in the product and to change position or direction as a result of this information. To locate and measure a variable we can employ such devices or instrumentation as photoelectric cells, oriented sound waves, mechanical or electrical feelers, etc., using these elements to detect directly or by computation from related, but more easily located, features.

Having located the proper point or position, we must then act on the product by appropriately marking, cutting, sawing or trimming. In this phase, some basic development work is needed inasmuch as the conventional cutting tools do not have sufficiently flexible response characteristics for the more sophisticated guidance and control systems. This problem, while challenging, is not beyond reach of present engineering research capability. I fully expect that within the next two years both the detection, guidance and cutting problems will be solved.

Since I expect this to be an evolutionary process, the attainment of the 12th level enables us to seriously consider the 14th level. Here we must identify and select appropriate sets of action. This is the sort of operation that is manually performed by the boner and trimmer. Again we have a good part of the tools—electronic detectors and counters; electrical and sonic probes, numerical control techniques, etc. The identification and selection problem can be automated today at a price. Perhaps this price is presently too high—especially when we still face the hurdle of flexible

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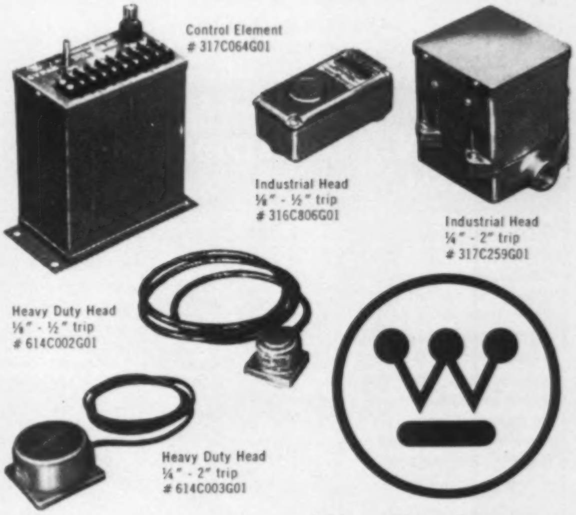

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Circle 713 on Page 19

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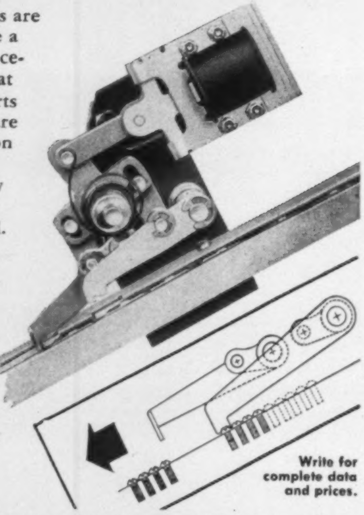

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Circle 714 on Page 19

cutting and trimming devices with instantaneous and reliable response.

If we consider a device operating at the 14th level of mechanization as yielding an approximation to the finished product, we may then transfer to a 15th level mechanism—correcting the performance after the operation. This in effect could be accomplished by a combination of measuring the characteristics (Level 9); segregation according to measurements (Level 13); and changing position and/or direction according to measurement signal (Level 12). While this stepwise approach is sound and quite likely, the evolution will result in a device operating at the 16th level of mechanization—correcting the performance while operating.

You will note that Level 17 has not been attained. Strange as it may seem, the step from Level 16 to 17 is the least difficult. Data processing equipment now in being can be programmed to compute the optimum cutting schedule for existing (and immediate future) market conditions.° With the cutting operations at the 16th level of mechanization, the control and guidance of these operations can be regulated by an on-the-line computer circuit. Nor is a single purpose computer required. Programs today can be handled so quickly that a single high speed computer can assimilate livestock market conditions, inventory status, processing costs, consumer requirements, etc., for the major market areas of the country and automatically print tapes for the control of a Level 16 operation at a number of processing plants. Progress in automation technique is advancing at a pace that makes this a very real possibility within the next five years! I am convinced that automatic disassembly is not impossible—nor is it too far away!

From a talk entitled "Automatic Disassembly—Meat Packers' Problems" presented at the Fifth Conference on Manufacturing Automation held at Purdue University, Lafayette, Indiana, April 1961.

MAINTENANCE FOR PRODUCTION

By R. E. SNIDER
Supt. of Maintenance & Construction
A. C. Spark Plug Div.
General Motors Corp.
Flint, Mich.

HOW do we accomplish good maintenance of electronic, hydraulic, and other instruments? Our procedure involves seven basic points: 1. Purchase quality equipment. 2. Develop personnel who will improve on the design of circuits. 3. Set up a standard of good practices. 4. Furnish personnel with good test instruments. 5. Carry on an organized preventive maintenance program. 6. See that the maintenance man has proper materials. 7 Hydraulic maintenance.

What is good preventive maintenance? This question could get a good many answers. There seems to be a varied and wide interpretation of preventive maintenance throughout industry. Some figure that if a piece of equipment starts to give too much trouble on repeat calls it is time to do the preventive maintenance work. Others will go to the opposite extreme of giving every piece of equipment very thorough attention at regular intervals.

We have set our system up as follows: We have a preventive maintenance number on each piece of equipment for identification. (Such as J-20 in a yellow square.) In this square there also is painted the property tag number. In our preventive maintenance office we have a master file for the pieces of equipment. From these we have obtained punched IBM cards that are dated by weeks. For example the 4th, 20th, and 36th week of the year might appear on the cards if the preventive schedule calls for a check three times a year.

We judge the frequency of preventive maintenance in three categories, as follows:

1. Automated or line-flow machinery that works a full shift or more and is our only source for that production. This we schedule quite regularly.
2. Machinery that is run periodically. This is not scheduled so often.
3. Equipment or machinery from which the job could be moved to other equipment without interferring with production. This is not on the preventive list.

The IBM department sends out all the cards for the month along with 2 copies of the tabulated run to the preventive maintenance office. This office in turn sends the cards for each week to the maintenance zones. These are divided up among the supervisors on all three shifts, depending on the shift where the work can be done best.

This naturally brings up the question of what detail we give the maintenance man in regard to which components he checks and how. Through the seven years we have practiced preventive maintenance, our experience tells us that in the great majority of cases it is best to dump it squarely in the maintenance man's lap, as his experience in working with the job every day tells him what components require the greater attention.

Many times, two control units are identical but used on kinds of equipment that have different demands on the unit, such as speed, cycle, setting, etc., and in some cases on the operating personnel. We have found that one component accounts for all the trouble on one unit, while it will be a different component on the other.

On some electronic control units they will replace all tubes at the same time. This is considered good practice where the total cost would not be beyond ten or twelve dollars and the machine is in a group of automated, line-flow production equipment. By line-flow, I mean the product travels from one machine to another, with no stock being kept between.

Another point worth mentioning is the fact that most machine troubles are due to mechanical adjustments and wear rather than electronic failure. On electronic failure it is our opinion they rate in the following order: Tubes, selector switches, variable resistors, capacitors, power packs, and rectifiers.

From a paper entitled "Upkeep of Electronic and Other Control Instruments" presented at the 12th Plant Maintenance & Engineering Conference held at Chicago, January 1961.

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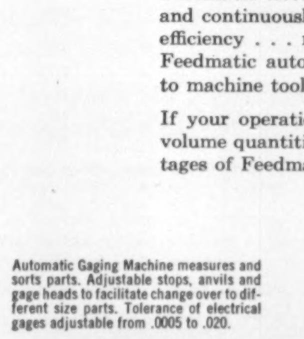
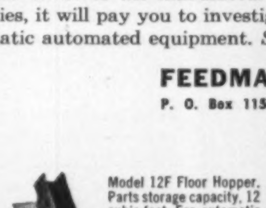
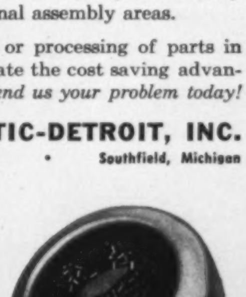


Model 12F Floor Hopper. Parts storage capacity, 12 cubic feet. For automatic feeding of larger parts.





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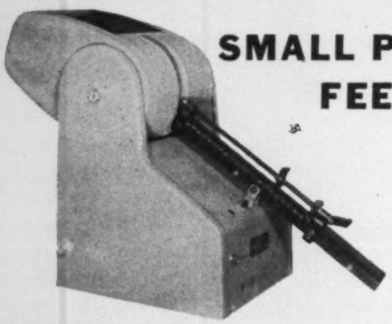

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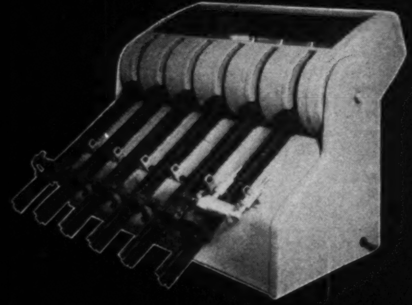

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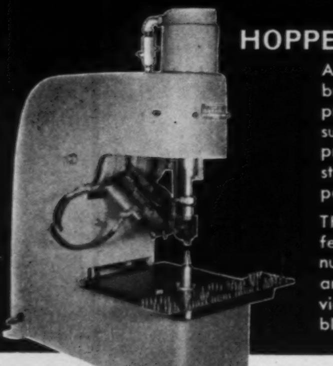

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Circle 715 on Page 19

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DID YOU KNOW THAT . . .

Problems concerning systems, equipment, or components for automated operations are invited. Submit to: The Editor, AUTOMATION, Penton Bldg., Cleveland 13, Ohio. Readers having solutions to problems are invited to submit them and should refer to problem title and case number.

INSPECTING HOSIERY — Case 2422-P

. . . There are many different things an inspector must look for when inspecting full-fashion and seamless hosiery, and most of these are a judgment of degree. It is possible that an adjustment might be made in tolerances, depending on how many stockings are involved in a given lot in which a particular defect or yarn variation occurs. However, the one quality check that is never altered is the length acceptance tolerance. It would be of considerable assistance if the lengths could be measured automatically and segregated into piles within 1/4-inch tolerances. If you have a manufacturer that could be of assistance in developing such a machine, I would appreciate your directing him to us . . . **General Superintendent**

MEASURING PAPER STACKS — Case 2423-P

. . . Our problem is the accurate measurement of the width, length, and squareness of a block of paper (500 or 1000 sheets), approximately 8½ by 11 inches in size or larger, as it travels down a conveyor between trimming and packing operations. The automatic measuring device must be able to measure within plus or minus 1/32 inch and preferably within plus or minus 1/64 inch . . . **Manager, Industrial Engineering**

LINE SENSING ELEMENT — Case 2425-P

. . . We are looking for a nulling-type sensing element that will respond to the presence or absence of light energy as reflected or not reflected from a line through an optical system. The cross-sectional area of the line, as viewed by the sensing element, will be approximately 1/16 square inch. It is intended that the screen upon which the line is drawn (approximately 10 by 15 inches) will be flooded by a 300 to 500-watt light source. No studies have been conducted to date to determine the light energy that is reflected from the cross-sectional area. Any element "peaking" in the ultraviolet, visible, or infrared regions would be considered . . . **Analog Operations Engineer**

BOXING WIRE PARTS — Case 2426-P

. . . We produce a silver part (about 1/32 inch diameter by 1⅜ inches long with 1/16-inch flat on one end) on a wire-forming machine at a rate of 600 per minute. The part must be aligned, but without preference as to which end is left or right, and packaged with 2500-3000 parts per box. We have tried vibratory feeders to automate this process with no luck. We are thinking of using a belt conveyor which would orient the part and drop it into a box, while indexing from front to back. The problem should be similar to that of packaging toothpicks or matches . . . **President**

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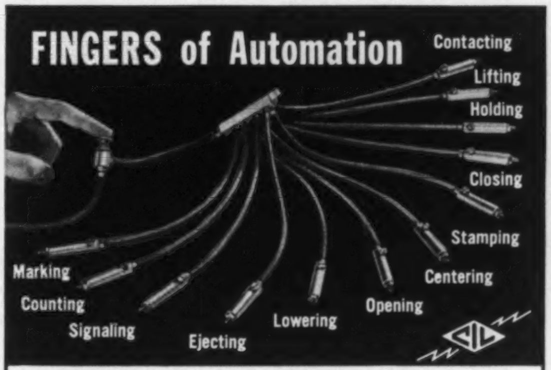

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Circle 718 on Page 19

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Circle 717 on Page 19

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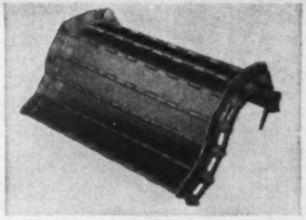

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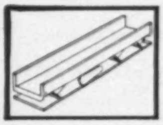
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Circle 719 on Page 19

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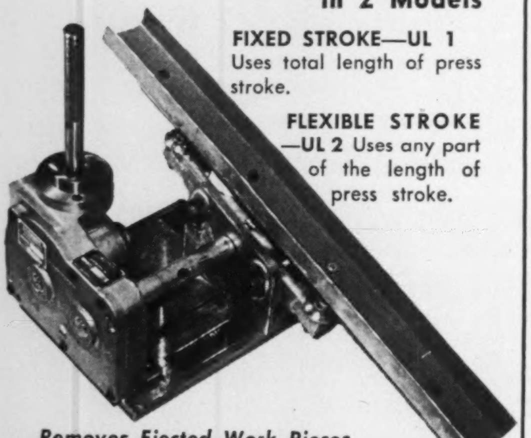

FIXED STROKE—UL 1 Uses total length of press stroke.

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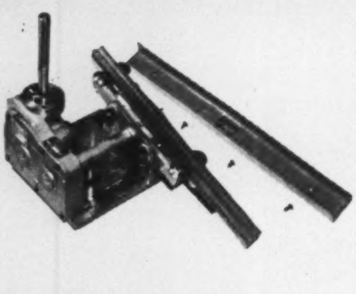

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Circle 720 on Page 19

AUTOMATION

new books

MAGNAGEMENT PROBLEMS IN THE ACQUISITION OF SPECIAL AUTOMATIC EQUIPMENT

By Powell Niland, professor of management, Washington University; 336 pages, 5 by 8 inches, published by Division of Research, Harvard Business School, Boston; available from AUTOMATION; *$5.00 postpaid.*

Research on which this book was prepared was carried on while the author was Asst. Professor of Business Administration at the Harvard Business School. The author examined the acquistion process in 18 different plants in order to develop a general description of what is involved in acquiring nonstandard, nonconventional automatic equipment.

DICTIONARY OF MECHANICAL ENGINEERING

By Alfred Del Vecchio, associate professor, director of mechanical engineering, Manhattan College; 346 pages, 6 by 9¼ inches, published by Philosophical Library Inc., New York; available from AUTOMATION; *$6.00 postpaid.*

Source book presents simplified definitions of terms used in the fields of architecture, automatic controls, engineering mechanics, fuels and combustion, power plants, welding, basic electricity, and basic mathematics. Also included are 21 pages of conversion factors.

BASICS OF ANALOG COMPUTERS

By T. D. Truitt, director of advanced study group, and A. E. Rogers, senior consultant, both with Electronic Associates Inc.; 400 pages, 6 by 9 inches, published by John F. Rider Publisher Inc., New York; available from AUTOMATION; *$12.50 postpaid.*

More than 400 illustrations help pinpoint the ideas expressed in this introductory text to analog computers. The book is especially writen for an engineering type reader who has had no experience with such computers. Subject organization proceeds from simple ideas to basic types of analog devices, mathematical concepts, general-purpose analog computers, and practical applications of computers.

THE MANAGER'S JOB

Edited by R. T. Livingston and W. W. Waite, both professors of industrial engineering, Columbia University; 459 pages, 5½ by 8½ inches, published by Columbia University Press, New York; available from AUTOMATION; *$10.00 postpaid.*

The body of this book is composed of papers selected from those presented during the past few years at the Utility Management Workshops sponsored by Columbia University. The various papers have been integrated into a thought provoking presentation under the major headings of: The Job of the Top Manager; The Job of Any Manager; The Manager and Human Relations; Communications and Management; Development of Managers; and Decision-Making.

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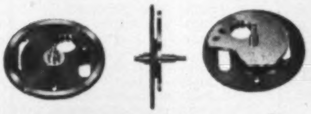

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Circle 721 on Page 19

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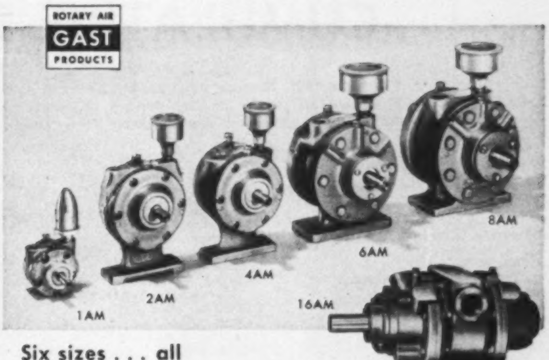

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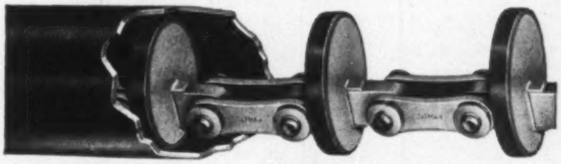

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Circle 724 on Page 19

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A

Adhesives, application, 3-41
Adjustable-speed drives, 5-68
Aidlin, S. S. and S. H.
  Producing Hinged Assemblies, 2-77
Alarm, explosive, 5-20*
Alexander, W. G.
  The Importance of Knowing, 4-51
Aluminum cans, 2-79
Amplifiers,
  power, 5-77
  voltage, 5-77
Analog recording systems, 5-56
Analysis, signal energy density, 2-13*
Anaylzer,
  fluid network, 5-26*
  process, 7-76
Assembly,
  adhesives, with, 3-41
  automobile bodies, 6-41
  automobile wheels, 4-68
  by riveting, 6-90
  copper bonding process, 3-9*
  general considerations, 3-143
  on four-slide machines, 2-68
  planning, 3-54
  stamping, 2-39
  stators, 3-74
  toilet seats, 2-77
  transistor elements, 3-87
Automation,
  at Volkswagen A. G., 6-41
  fifth conference, 6-10*
  French railroads, 2-47*
  legal implications of computers, 4-56
  organization for, 2-73
  philosophy, 5-46; 7-53
  social effect in power plants, 2-158
  stock exchange, 2-9*
  survey, 7-35
  technological change, 2-154
Automation and Manpower,
  Advisory Committee, 6-9*; 7-53
  Office of, 6-9*; 7-53
AUTOMATION Product Review, 4-10*

B

Balancing, static, 4-68
Barrel plating, 4-13*
Batch weighing, 3-71
Beck, G. H.
  Computers & Liquid Pipelines, 6-161
Beck, P. W.
  Automatic Diode Tester, 7-67
Bennett, W. S.
  Programmed Testing, 5-137
Biddison, J. M.
  Automatic Assembly System, 3-74
Binary readout, 3-82; 4-70
Blechman, S.
  The Versatile Rotameter, 2-156
Bolz, R. W.
  Attitudes, outlook, 7-4
  Survey Report and Forecast on Automation Trends, 7-35
Brazing, mechanized, 3-81
Buchanan, T. C.
  Fixturing for Riveting, 6-90

C

Caban, N. L.
  Control Versatility, 6-155
Cam follower, 2-26*
Carlson, R. E.
  Making Parts from Wire and Strip, 2-68
Carpenter, J.
  Industrial Hydraulic Circuits, 6-71; 7-83
Casting,
  aluminum engine parts, 4-39*; 6-86
  aluminum strip, 5-52
Catalog system, 4-19*
Check handling equipment, 4-30*
Checkout, 4-49*
Chemical,
  metering movie, 6-16*
  ore reduction, 3-47*
Chope, H. R.
  Developing Control Systems, 7-76
Coating, steel pails, 5-65
Code recognition, magnetic, 4-70
Coding chinaware, prob., 6-166*
Computers,
  aircraft maintenance, 5-73
  boiler control, 3-141
  legal implications of use, 4-56
  maintenance, 6-88
  pneumatic, 3-13*
  power plants, 3-10*
  process control, 7-76
  rental plans, 2-13
  small companies, 2-152
Controlled approach positioning systems, 5-77
Controls,
  adaptive, 6-164*
  automatic, 5-46
  computer, 4-9*
  computers, for boilers, 3-141
  conveyor scale, 5-66
  cylinder speed, 2-86
  electrical American standards, 5-146*
  fractionator system, 3-18*
  load sensing conveyor, 3-78
  machine loading system, 4-90
  magnetic conveyor, 4-70
  magnetic tape, 5-56
  material feed, 2-54
  numerically controlled machine tools, 3-75
  order picking, 7-70
  photoelectric, 4-94
  plastic extrusion, 3-91*
  pneumatic, 2-86
  process, 2-47*
  rubber cutting press, 7-54
  static machine, 6-9*
  system, contouring, 5-24*
  systems engineering, 3-148*
  system philosophy, 4-16*; 7-76
  transfer machine, 3-58
  weighing, 3-82
Conveyors,
  can, 2-79
  coal, 2-62
  finishing system, 5-84
  load sensing, 3-78
  loader, 6-67
  magnetically controlled, 4-70
  order picking, 7-70
  overhead, 4-63
  scale, 5-66
  systems, 5-18*
Costs, reduction, 2-159*; 5-146*
Counters,
  core-transistor, 5-10*
  newspaper stacking, in, 7-95
  word, 2-31*
Counting small parts, prob., 6-166*
Current conductor
  system, 6-10*
Cutting, book threads, 2-61

D

Darmody, T. R.
  Maintenance of Computer Systems, 6-88
Data collection system, 2-149
Data handling, 5-46
Data processing, 2-9*; 4-9*
  activity in Japan, 5-42*
  battery operated computer, 5-23*
  check out equipment, 6-10*
  computer, 5-15*, 73
  digital data system, 6-18*
  French railroads, 2-47*
  graphic recording of production, 4-87
  magnetic tape, 5-56
  magnetically imprinted checks, 6-27*
  memory file, 5-10*
  mobile system, 3-18*
  multi-industry center, 4-151
  orders & invoices, 5-39*
  storage & retrieval unit, 6-26*
  tape controlled lathe, 3-62
  warehousing, 7-70
Davis, H. C.
  Planning Automated Assembly, 3-54
Design, of fluid power cylinders, 2-86
Detector,
  fault, 3-20*
  flaw, 6-18*
Diebold, J.
  National Implications of Automation, 6-160
Digital,
  contactors, 4-73
  magnetic drum transducers, 4-73
  recording systems, 5-56
Dispatching, product units, 4-70
Document retrieval, 2-13*
Dressing grinding wheels, 4-16*
Drilling,
  multiple head, 5-64
  table, 3-92
  tape-controlled, 3-9*
Drives,
  adjustable speed, 5-68
  mechanical-hydraulic, 5-68
Drying, metal parts, 3-29*

E

Economics, of four-slide forming, 2-68
Electrical system testing, 4-49*
Electronics,
  maintenance, 6-88
  telephone switching system, 2-9*
Engineering,
  automated assembly, 3-54
  creative design, 6-164*
  manufacturing, 7-62
  use of analog computations, 6-164*
Esken, R. L.
  Elements of Automatic Assembly, 3-143
Evans, C. D.
  Organizing to Reduce Costs Through Automation, 2-73

F

Falcon, C. J.
  Load Sensing Conveyor, 3-78
Feedback systems, position, 4-73
Feeders,
  magazine, 3-87
  sheet, 6-78
Feeding,
  discrete parts, 3-87
  paper sheets, 6-78
Feirn, F. C.
  Sensing With Photoelectrics, 4-94
Finishing,
  paint spray unit, 6-20*
  system, 5-84
Fixtures, riveting, 6-90
Fluid power,
  cylinders, 2-86
  terms, 6-164*
Forecast, automation trends 7-35
Forging presses, 5-29
Forming,
  welding chain, prob., 4-164*
  wire & strip, 2-60
Four-slide machines, 2-68
Freed, R. N.
  Legal Implications of Computer Use 4-56
Furnaces, 5-29
  electric, bottle glass, 3-13*
  industrial, 6-12*

G

Gaging,
  gamma ray systems, 6-15*
  pneumatic, 4-22*
  thickness, 7-94
  x-ray emission, 7-94
Gochenour, O. C.
  Planning for Maintenance, 4-156
Graphic recording of production, 4-87
Gray code, 3-82
Guide rings, 6-10*

H

Halfhill, D. W.
  Controlling with Magnetic Tape, 5-56
Handling,
  bauxite ore, 5-66
  belt lengths standardized, 6-10*
  bread pans, 7-92
  bundles in newspaper mailrooms, 7-95
  cans, 2-79
  carburetor air horns, 6-67
  cement, 3-13*
  coal, 2-62
  conveyor belt system, 6-21*
  conveyor system, 5-18*
  dispatching bundles, 3-91*
  feeding, 3-87
  food products, 3-26*
  garments, prob., 5-142*
  machine line loading, 4-90
  magnetic routing system, 6-16*
  mail, 3-16*, 50*: 5-9*
  newspaper stacking, 7-95
  paper products, 6-78
  railroad wheels, 3-58
  remote controlled, 3-13*
  small parts, prob., 6-166*
  steel coils, 2-85
  transistor & diodes, prob., 2-162
  warehousing, 7-70
Heat, processing, 4-81; 6-41
Hecox, W.
  Applying Optoelectrical Readout, 3-82
Hensgen, B. T.
  Automatic Disassembly, 7-143
Humphrey, J. R.
  Tricks in Handling Paper Products, 6-78
Hydraulics,
  basic sequencing methods, 6-71
  counteracting gravity, 7-83
  cylinder application guides, 2-86
  drive system, 5-68
  force control devices, 6-71
  multi-actuator system considerations, 7 83
  position control devices, 6-71
  pumps and controls, 7-83
  sequencing one cylinder, 6-71
  sequencing fluid motors, 7-83
  sequencing multiple cylinders, 7-83
  time control devices, 6-71
  velocity control devices, 6-71

I

Induction heating, 6-41
Inductive plate transducers, 4-73
Inspection,
  in-process, 3-58
  paper flaws, 5-39*
  photoelectric 4-94
  system, pallets, 7-92
  weighing, 3-82
Instrumentation,
  response testing, 2-159*
  system, 5-18*
Investments, in overseas plant, 2-50*

J

Joining, 3-41

K

Keebler, J. C.
  None Too Good, edit, 7-61
Kessler, G. W.
  Computer Control of Boilers, 3-141
Kirk, H. A.
  Using Patent Literature Effectively, 2-54

---

*Asterisks indicate brief items appearing in departments.

L

Labor-management
  Presidential Advisory
    Committee on, 7-53
Lansky, Z. J.
  Practical Guides to Power Cylinder Application, 2-86
Lathe, liquid, 6-9*
Leasing, equipment, 2-16*; 6-12*
Legal implications of computers, 4-56
Limit switches, handling control, 4-90
Linear programming, 2-158*
Lining, steel pails, 5-65
Lip seal testing, 4-49*
Lithographing, toothpaste tubes, 5-52
Loading, machine tool line, 4-90
Lubricants, selection, 2-96

M

Machine tools,
  die cutting machine, 5-15*
  drilling & tapping, 5-64
  forging presses, 5-29
  loading, 3-90*
  numerically controlled, 3-75, 92; 6-60, 85
  transfer, 2-39; 3-58
  turret lathe, tape controlled, 3-62
Machines,
  aluminum can, 2-79
  aluminum tube-making, 5-52
  assembly, 3-74, 87
  automatic merchandising, 3-24
  Braille printing, 3-50*
  brazing, 3-81
  cigarette making, 7-76
  coal mining, 2-62
  dial indexing, 2-96
  diode tester 7-67
  drilling and boring, 2-54
  four-slide, 2-68
  joined by transfer bar, 2-82
  lapping, 6-12*
  marking, 4-42*
  newspaper stacker, 7-95
  plastics molding press, 4-154
  riveting, 6-90
  sawing aluminum, 5-76
  spring making, 2-16*
  thread cutting & trimming, 2-61
  toilet seat assembly, 2-77
  wafering, 6-12*
  weighing, 3-82
  welding, 3-75; 6-9*
Magnetic,
  amplifiers, 5-77
  conveyor control, 4-70
  core devices, 5-146
  pin transducers, 4-73
  tape systems, 5-56
  tooth transducers, 4-73
Magnetifc tape,
  controlled lathe, 3-62
  preparation center, 4-83
Maintenance, 5-45
  aircraft with computer, 5-73
  computer, 6-88
  data collection, 2-149
  electronic items, 7-146
  of fluid power cylinders, 2-86
  programmed mill, 4-156
Management,
  information & control system, 3-148*
  of distribution function, 6-164*
Manufacture of,
  alternator stators, 3-74
  aluminum cans, 2-79
  aluminum foil, 7-94
  automobiles, 4-68; 6-41
  automotive parts, 2-39; 3-41; 4-81; 5-29
  books, 2-61
  concrete, 3-71
  concrete tiles, 4-39*
  connecting rods, 4-90
  copper & copper products, 3-47*
  electric motors, 4-81
  engine blocks, 2-39
  engine castings, 6-86
  floor tile, 4-64
  forgings, 5-29
  hats, 2-50*
  magnetic tape, 5-12*
  pails, 5-65
  petroleum products, 2-47*
  pipe, 5-68
  railroad wheels, 3-58
  rubber mats, 7-54
  sheet metals, 3-10*
  shingles, 4-93
  strip parts, 2-68
  toothpaste tubes, 5-52
  transistors, 3-16*, 87
  tubular heating elements, 2-82
  typewriter parts, 5-84
Volkswagen cars, 6-41
  wire parts, 2-68
Manufacturing engineering, 4-10*; 7-62
Manufacturing Engineering Council, election of officers, 6-12*
Manufacturing research, 2-73; 6-59
Marking tubes, 7-92
Mastic application, 2-39
Mathematics, 3-148
Mays, B. L.
  Automation in Newspaper Mailrooms, 7-95
Measuring,
  moisture, 2-13*
  tensile, test specimens, prob., 5-142*
  tension in filaments, 4-26*
Meat packing, 7-143
Memory wheel, 2-54
Mining coal, 2-62
Mixing, 2-16*; 4-64
Mobile concrete batcher, 3-71
Modersohn, C. W.
  Mechanical-Hydraulic Drive, 5-68
Moe, J. E.
  Magnetic Tape Control of Turret Lathe, 3-62
Molding,
  Braille characters, 3-50*
  glass, prob., 2-162*
Morse, C. W,
  Manufacturing Engineering Today, 7-62
Motors, dc, 5-12*
Mounting, fluid power cylinders, 2-86
Muschamp, G. M.
  Tomorrow's Integrated Offices and Plants, 5-46

N

Network synthesis, 2-158*
Numerical control, 4-10*
  jib borer, 6-24*
  magnetic tape for, 5-56
  management considerations, 6-60
  milling machine, 6-85
  structural steel drilling machine, 3-75
  tape preparation centers, 4-83
  turret lathe, 3-62

O

Office automation, 5-46
Olesten, N. O.
  Steppingstones to Numerical Control, 6-60
Optical gratings, 4-73
Optoelectrical readout, 3-82
Order picking, 7-70
Organization,
  for manufacturing engineering, 7-62
  for numerical control, 6-60
Organizing for automation, 2-73
Orienting gallon jugs, prob., 6-166*

P

Packaging,
  carton strapping, 6-22*
  machines, tetrahedron, 4-10*
  napkin, 3-91*
  transistors, 4-16*
  undergarments, prob., 4-164*
Painting, 3-75; 5-84; 6-41
  strip aluminum, 3-16*
Pasteurizer-cooler, 6-24*
Patent classifications, 2-54
Patterson, K. M.
  Improved Manufacturing Flow, 5-139
Photoelectric, control, 4-94
Pie coating, 4-93
Pipes,
  bimetallic, 2-24*
  continuous buttweld, 5-68
Planning,
  automated assembly, 3-54
  production inventories, & work force, 3-150*
  production processes, 7-62
Plumbing terms, 3-150*
Pneumatic, cylinder application guides, 2-86
Position memory system, 7-92
Positioning,
  controls, 4-73
  system, 5-77; 6-23*
Potentiometer position transducers, 4-73
Presses,
  block, safety, 3-22*
  laminating, 3-28*
Printer, rotary spot, 6-15*
Printing tubes, electrostatic, 2-30*
Press, rubber cutting, 7-54
Process,
  bauxite ore refining, 5-66
  coal mining, 2-62
  copper reduction, 3-47*
  pail lining, 5-65
  paper products, 6-78
Production control, 4-87, 92; 6-164* 7-76
Production of electronic circuit components, 2-16*
Programming,
  classes, 6-22*
  electrical test, 4-49
  mill operation, 6-20*
  numerical control, 6-60
Psychology, industrial, 2-158*
Pulse transducers 4-73
Pumps,
  flexible tube, 4-24*
  multipurpose, 2-19*
Punched card,
  order picking, 7-70
Punched tape,
  maintenance data collection, 2-149

Q

Quinn, J. D.
  Recording Performance Data, 2-149

R

Railroads, automatic identification of equipment, 3-9*
Ray, W. A.
  Control System Philosophy, 4-16*
Reading car numbers, problem, 3-154*
Recorders,
  graphic display production data, 4-87
  magnetic tape, 5-56
  microfilm, 4-10*
  temperature, 6-77
Rectifiers, industrial, 3-13*
Research, manufacturing, 6-59
Resolvers, 4-73
Rinsing cans, 7-93
Riveting, 6-90
Robertson, M. E.
  Comments on Technological Change, 2-154
Rolling,
  aluminum products 7-94
  steel bar products, 4-93
Rotameter, 2-156
Rubber lining material, 6-10*

S

Sand reclamation system, 4-31*
Sarnoff, D.
  Potential for the Sixties, 3-147
Sawing machine, 5-76
Seals, for fluid power cylinders, 2-86
Selecting fluid power cylinders, 2-86
Semiconductor device operation, 6-164*
Sensing,
  cutting depth, prob., 3-154*
  drill breakage, prob., 3-154*
Sensors,
  magnetic, 4-70
  photocell, 4-94
  weather, 3-16*
Servo positioning systems, 5-77
Servos, incremental, prob., 3-154*
Setscrew driving, 4-92
Sintering, copper powder, 3-47*
Snider, R. E.
  Maintenance for Production, 7-146
Soldering type bars, prob., 2-162*
Sorting,
  by weight, 2-54
  paper sheets, 5-39*
  photoelectric control, 4-94
  punched cards, 2-54
Speaker, R. L.
  Distribution Materials Handling, 6-157
Speed, regulator, 2-54
Stackers, paper sheet, 6-78
Stacking parts, prob., 4-164*
Stampings, assembly of, 2-39
Standards,
  electrical diagrams, 3-150*
  fluid power cylinders, 3-150*
  signalling apparatus, 3-150*
Static balancing, 4-68
Storage, steel, 3-90*
Straightening tubing, 3-90*
Strip forming, 2-68
Stripping insulation, prob., 4-164*
Survey, automation, 7-35
Switching circuits, for position transducers, 5-77
Synchros, 4-73

T

Tape,
  magazine, interchangeable, 2-28*
  preparation, 3-62
Tape control,
  drilling machine, 3-92
  preparation centers, 4-83
  turret lathe, 3-62
Tapping,
  multiple head, 5-64
  unit, 6-16*
Telemetering, 5-46
Temperature,
  measuring photocell, 4-98
  recording system, 6-77
Testing, 4-49*
  air conveying systems, 2-22*
  diodes, 7-67
  kiln temperatures, 6-77
  tubular heating elements, 2-82
  wires, 6-28*
Thurman, C. H.
  Plant Modifications for Computer Control, 5-135
Tool setting comparator, 4-28*
Toothed magnetic drum transducers, 4-73
Transducers,
  photocell, 4-94
  position, 4-73
Transfer devices, 2-82
  machines, 2-39
  machining & assembly, 4-92
Transfer machines,
  carburetor air horns, 6-67
Transistor, 2-159*
  amplifiers, 5-77
  assembly, 3-87
  strip alloying process, 3-10*
Trimming, book threads, 2-61
Troupe, W. B.
  Continuous Heat Processing, 4-81
Turnovers, 6-67
Tying knots, prob., 4-164*

V

Vacuum, parts feeding, 3-87
Vacuum tube amplifiers, 5-77
Valves, testing, 4-49*
Van Horne, W. E.
  Graphic Recording of Production, 4-87
Verification of control tapes, 4-83
Vibrating small masses, prob., 2-162*
Vibrational compactor, 2-20*

W

Walker, J. R.
  Elements of Positioning Controls, 4-73; 5-77
Warehousing,
  operations planning, 3-148*
  order picking, 7-70
Weighing,
  batch, 3-16*
  binary code, 3-82
Welding,
  assembly machines, 6-41
  auto bodies, 6-41
  coil ends, 2-85
  pipeline, 4-13*
  ultrasonic, 6-164*
Wesley, G. A.
  Computers & Small Companies, 2-152
Wilburn, R. C.
  Answers to Numerical Control, 4-83
Wilson, R.
  Compression Molding Cost Factors, 4-154
Winding, stator coils, 3-74
Wire, forming, 2-68
Wrapping bottles, 7-93

X

X-ray, thickness gage, 7-94

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For further information on anything described or advertised in this issue . . . .
SEE Page 19

Advertising Index

Acme Manufacturing Co. 120
Air-Hydraulics, Inc. 126
American Brake Shoe Co., Denison Engineering Division 102
Anchor Steel and Conveyor Co. 2
Armour Research Foundation of Illinois Institute of Technology 149
Automation Machines & Equipment Co. 135

Barkley & Dexter, Inc. 122
Bellows-Valvair, Division of International Basic Economy Corporation 119
Bendix Corporation, The 59
Brown, James G., & Associates 149
Burgmaster Corporation 112, 113

Cincinnati Milling Machine Co., The, Special Machine Division 6, 7
Clippard Instrument Laboratory, Inc. 149
Columbia University Press 140
Columbus McKinnon Corporation, Conveyor Division 24
Crown Zellerbach Corporation, Gaylord Container Division 12
Cutler-Hammer, Inc. 14, 15

Denison Engineering Division, American Brake Shoe Co. 102
DeVilbiss Co., The 60
Dixon Automatic Tool, Inc. 146
Dynamatic Division, Eaton Manufacturing Co.. 127

Eaton Manufacturing Co., Dynamatic Division. 127
Eonic, Inc. 151
Erie Pacific Division, Erie Resistor Corporation. 128
Erie Resistor Corporation, Erie Pacific Division 128

Fairbanks, Morse & Co., Scale Division 105
Feedall, Inc. 118
Feedmatic-Detroit, Inc. 147
Flick-Reedy Corporation, Miller Fluid Power Division 11
Friden, Inc. 101

Gagne Associates, Inc. 135
Gardner-Denver Co. 141
Gast Manufacturing Corporation 151
Gaylord Container Division, Crown Zellerbach Corporation 12
General Dynamics Electronics, Stromberg-Carlson 128
General Electric Co. 55, 124, 125
Globe Tool and Engineering Co., The 134
Gray Equipment Co. 144

Haberstump-Harris, Inc. 148
Halliburton Co., Special Products Division ... 131
Hannifin Co., A division of Parker Hannifin Corporation 52
Hapman Corporation, Conveyor Division 151

Illinois Institute of Technology, Armour Research Foundation 149
Industrial Electronic Engineers, Inc. 135
International Basic Economy Corporation, Bellows-Valvair Division 119

Jergens Tool Specialty Co. 151

Lincoln Engineering Co., Division of The McNeil Machine & Engineering Co. 22, 23
Lincoln Tool & Manufacturing Co. 58
Livernois Engineering Co. 150
Lucas-Rotax, Ltd. 116

Magnetics, Inc. 115
Mahon, R. C., The, Co. 142
Mathews Conveyer Co. 133
Matthews, Jas. H., & Co. 25
McNeil Machine & Engineering Co., The, Lincoln Engineering Co. Division 22, 23
Micro Switch Division of Minneapolis Honeywell Regulator Co. 107
Miller Fluid Power, Division of Flick-Reedy Corporation 11
Minneapolis Honeywell Regulator Co., Micro Switch Division 107
Modern Machine Tool Co. 129

National Acme Co., The 56
National Air Vibrator Co. 132
Norden, Division of United Aircraft Corporation 28
Numatics, Inc. 8

Ohio, State of, Department of Industrial & Economic Development 156
Oilgear Co., The 5

Parker Hannifin Corporation, Hannifin Co. Division 52
Pathon Manufacturing Co. 123
Perfecting Service Co. 21
Post Electronic Products, Division of Reid Brothers Co., Inc. 111
Prab Conveyors, Inc. 149
Precision Detroit Co. 140

Reid Brothers Co. Inc., Post Electronic Products Division 111
Reliance Electric and Engineering Co. 26, 27
Reuland Electric Co. 136
Ross Operating Valve Co. 1

Schrader's, A., Son, A Division of Scovill Manufacturing Co., Inc. 139
Scovill Manufacturing Co., Inc., A. Schrader's Son Division 139
Simplicity Engineering Co. 146
Square D Co. ....Inside Back Cover
Stromberg-Carlson, General Dynamics Electronics 128
Sylvania Electric Products, Inc., Lighting Division 121

U. S. Electrical Motors, Inc. ....Back Cover
United Aircraft Corporation, Norden Division.. 28
United States Steel Corporation, United States Steel Supply Division 109
United States Steel Supply, Division of United States Steel Corporation 109
Universal Relay Corporation 154

Vac-U-Lift Co. 130

Wagner Electric Corporation 58
Wean Equipment Corporation....Inside Front Cover
Webb, Jervis B., Co. 51
Westinghouse Air Brake Co., Industrial Products Division 155
Westinghouse Electric Corporation 145
Westinghouse Electric Corporation, Standard Control Division 29, 30, 31, 32, 33, 34

Classified Advertising 154

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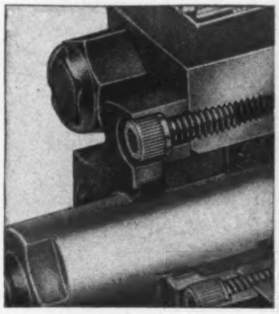

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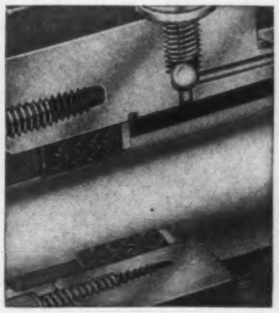

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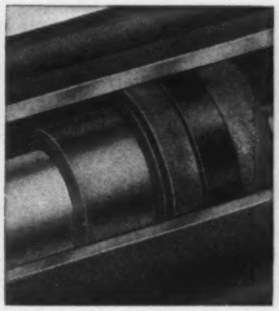

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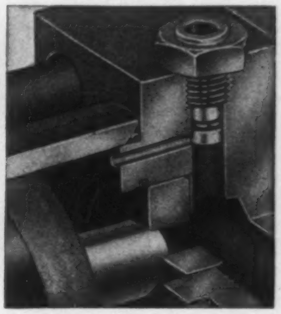

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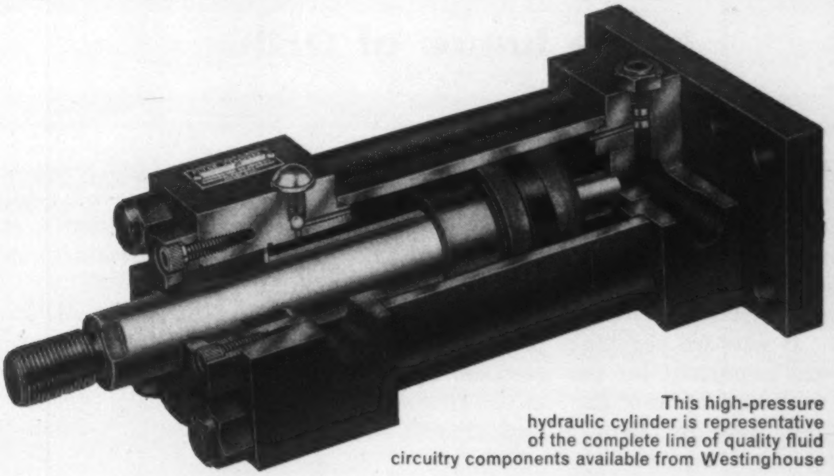

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Circle 726 on Page 19

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Circle 727 on Page 19

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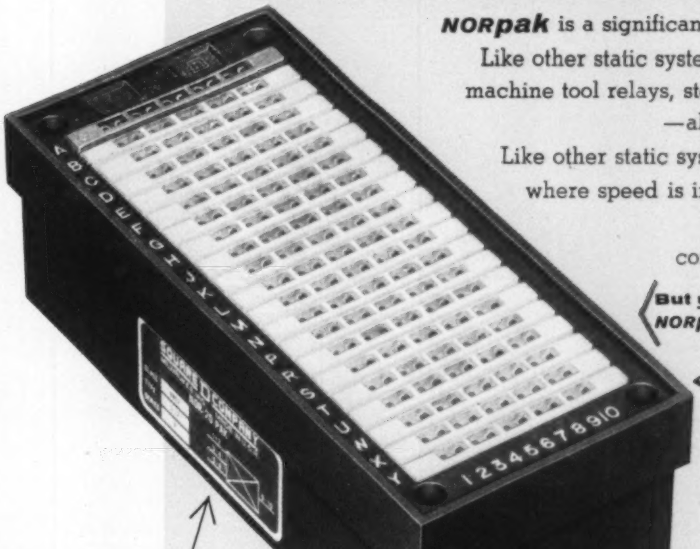

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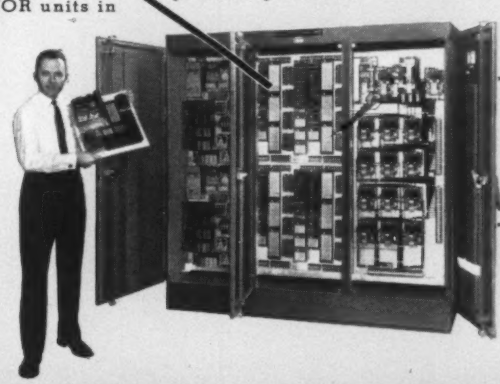
NOR units have been time-tested in computer use for years. They are not subject to wear, will give top performance indefinitely, and provide unfailing circuit fidelity.

SIMPLE TO USE

Optional monitor lights give visual evidence of proper performance. Simple dynamic sequence tester checks individual NOR units in operation.

EXPERT APPLICATION HELP

Field specialists, factory-trained in all aspects of **NORpak** can give you on-the-spot answers to any application questions.



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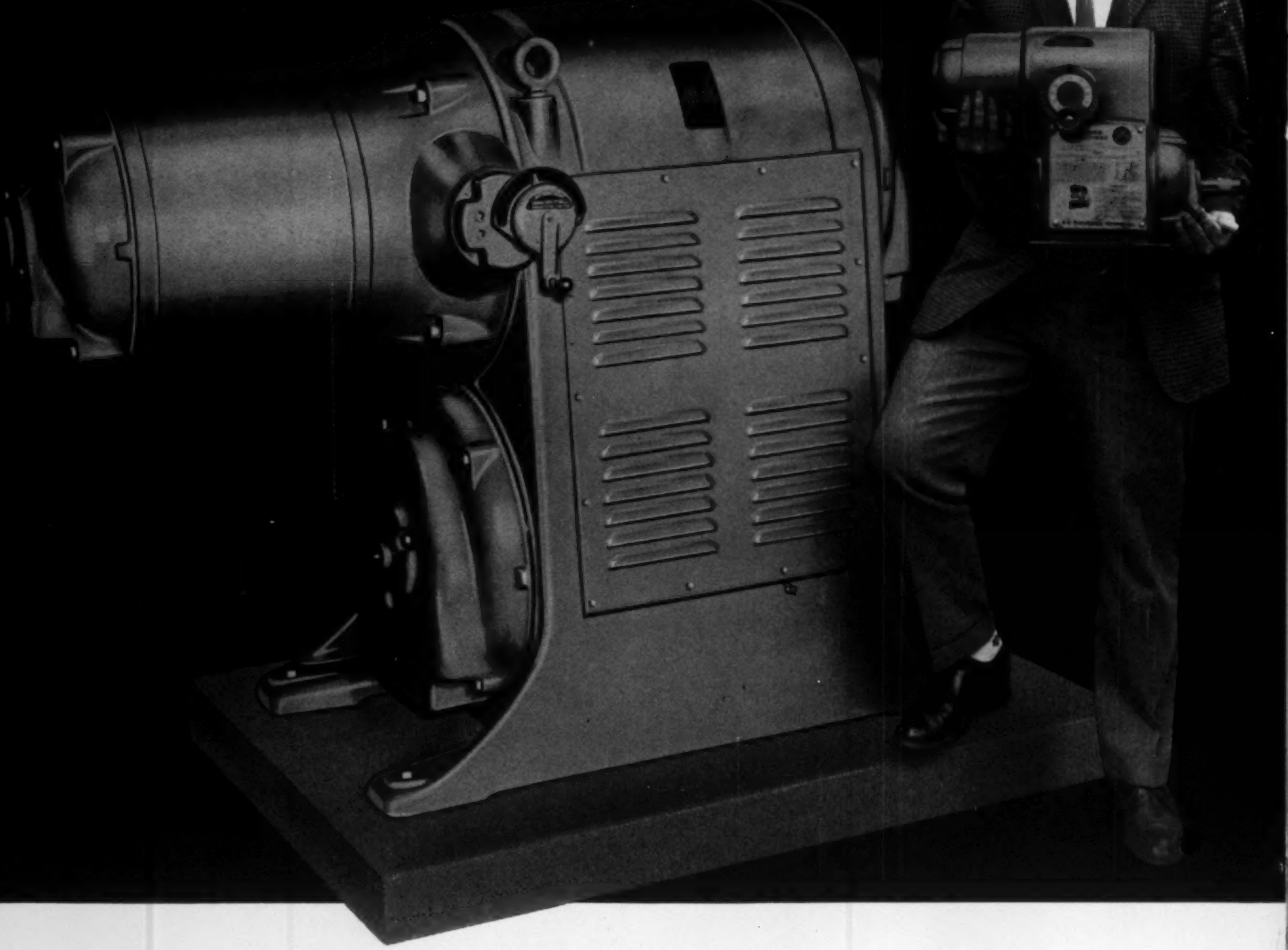

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